Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

86-04115/

TO HER HONOUR
HELEN HUNLEY
LIEUTENANT GOVERNOR OF THE PROVINCE OF ALBERTA

Madam;

I have the honour to submit the Annual Report of the **ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY** for the fiscal year ended March 31, 1985.

Respectfully submitted

JOHN ZAOZIRNY
Minister of Energy
and Natural Resources

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

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Foreword

On January 14, 1974, the Premier of Alberta announced the availability of $100 million to develop new technology for the recovery and processing of petroleum from the Alberta oil sands. The terms and conditions for the disbursement of these funds are described in The Oil Sands Technology and Research Authority Act, passed by the Legislature in June 1974 and since amended to include the recovery of heavy oils and the enhanced recovery from conventional petroleum reservoirs. An additional $368 million has since been dedicated by the Alberta Government to permit the funding of longer term programs.

AOSTRA Field Pilot Projects

Figure 1

Chairman's Report

Tenth Annual Report of the Alberta Oil Sands Technology and Research Authority

To The Honourable John Zaozirny
Minister of Energy
and Natural Resources

Sir:

I have the honour to present the Tenth Annual Report of the Alberta Oil Sands Technology and Research Authority (AOSTRA) for the year ended March 31, 1985.

AOSTRA continued to make good progress during the year in developing new or improved technology for the exploitation of Alberta's oil sands and heavy oil deposits, including a start on construction of the Underground Test Facility in Athabasca. Efforts to improve the enhanced oil recovery technology for conventional oil also progressed during the period and significant steps were made in mining and extraction projects. A dry retorting process which should overcome the shortcomings of the presently employed Hot Water Extraction Process is now ready for demonstration.

Announcements by some industry partners of their intention to commence construction and engineering on commercial projects using jointly developed technology, is an indication of the success of past AOSTRA programs. Continued commercialization of the oil sands and heavy oil reserves will ensure the future of an Alberta oil industry and government revenues from the production.

The major AOSTRA/industry field pilots located in the various oil sands and heavy oil deposits continued during the year. The highlights of these projects and other activities are outlined below:-

Athabasca Deposit

☐Early in 1984, AOSTRA signed an agreement with Amoco Canada Petroleum Company Ltd. and Petro-Canada Inc. to conduct pilot tests using steam and steam plus additives processes developed at the Alberta Research Council.

☐Encouraging results have been obtained from the steam drive process tests carried out at the Canterra Energy Ltd./Tenneco Energy Ltd. pilot. Further tests will be carried out throughout 1985, based on these favorable results.

☐During this fiscal year, work began on an Underground Test Facility. Drilling and lining of the first shaft is near completion and AOSTRA will continue to develop a preferred process for piloting from the UTF with industry cooperation.

☐AOSTRA is currently seeking third party participation for the large-scale demonstration of UMATAC Industrial Processes Division of UMA Engineering Ltd.'s Taciuk Processor. Evidence from technical and economic evaluations has shown a definite advantage for this process over the combined Hot Water Extraction and Flexicoking processes.

Peace River Deposit

☐Shell Canada Resources Limited has received ERCB approval to expand their pilot to a 1600 m^3/d commercial demonstration project. AOSTRA will not be a direct participant in the commercial venture; however, the technology developed with AOSTRA during the pilot stage will be utilized in the new project.

Cold Lake Deposit

☐The BP Exploration Canada Ltd. Marguerite Lake pilot project is now in its seventh year of operation. This project has successfully demonstrated the economics of steam stimulation in a thinner Cold Lake reservoir and resulted in the construction of the commercial Wolf Lake project. The pilot continues to test a novel recovery process using oxygen which promises to increase recovery beyond that achieved by steam stimulation.

Carbonate Deposit

☐The five-spot pattern at the Union Oil Company of Canada Ltd. McLean pilot was completed in 1983. Although the test results were not as successful as anticipated, a new single-well cyclic steam test will be conducted during 1985, at a new location.

Enhanced Recovery of Conventional and Heavy Oils

☐The Alberta Energy Company Ltd. pilot, located in the glauconitic sandstone is testing a wet combustion process. Production has been shown to be significantly greater than that which might have been expected under primary production.

☐Vikor Resources Ltd. has been operating a CO_2 miscible flood pilot in the abandoned Joffre Viking pool near Red Deer. Results to date have prompted the owners to plan a commercial expansion which is expected to begin operation in late 1985.

Major Studies Involving Industry Participation

☐The Upgrader Demonstration Project will conduct various tests to demonstrate the performance and operability of selected processes to establish their commercial applicability for upgrading plants.

☐The Upgrading Residue Utilization Project will identify, evaluate, and eventually test the most promising technologies for the economical and environmentally acceptable utilization of upgrading residues.

☐The Lloydminster Area Processing Study, initiated by Murphy Oil Company Ltd., will investigate the options for continued production and transportation of Lloydminster heavy oil.

☐The Bitumen Water Transportation Study will examine existing technologies and evaluate the pipeline transport of mixtures of bitumen and water.

Other Activities

☐The DRB Upgrading Process developed by Gulf Canada Resources Inc. has been tested and offers the potential of lower costs, simplicity, and improved operability over current commercial upgrading processes. AOSTRA is negotiating a project agreement with Gulf to participate in further development.

☐Research work being carried out at Canadian universities continues to produce very interesting results. Patents have been issued to researchers on two projects indicating some very promising developments.

☐The technical review commissioned in 1983 was completed on March 31, 1985. Experts from around the world assisted in the evaluation of all projects funded by AOSTRA over the 10-year period and presented their recommendations for further development or alternate research. The results and recommendations will be highlighted in a 10-Year Review to be published early in 1986.

☐Industry participation in AOSTRA-funded projects at the Alberta Research Council has encouraged the Oil Sands Research Department to focus more directly on the Cold Lake oil sands. A new jointly funded project at the Alberta Research Council is designed to establish a research capability in Alberta for upgrading of bitumen, and to do bench-scale/pilot-scale experiments to develop promising processes discovered by other AOSTRA-supported projects.

☐AOSTRA continued to pursue international technical exchanges with such countries as People's Republic of China, Albania, and Romania.

As AOSTRA concludes 10 years of operation, a number of projects present themselves as the success stories they are. The Taciuk Processor, as a viable alternative to the Hot Water Extraction Process, has proven itself at the pilot stage and must now be allowed the opportunity to prove itself further at the large-scale demonstration level. The success of the Vikor Enhanced Oil Recovery Project has already caught the interest of operators of similarly depleted fields, and they will hopefully be encouraged to apply the AOSTRA technology to their own operations. A bold new step by AOSTRA is the construction of the Underground Test Facility which will enable interested companies to utilize the facility to test processes requiring horizontal wells.

Technology developed jointly by AOSTRA and industry is now being used in two commercial ventures. The possibilities of this type of commercialization occurring again seem unlimited. With the assistance of an improved and growing data information base, broadening expertise of AOSTRA staff, and recommendations from the technical audit reports, we look forward to the continuing development of improved oil sands technology for the exploitation of Alberta's vast hydrocarbon reserves.

Respectfully submitted,

R.D. Humphreys
Chairman

Members of the Authority

Chairman
Dr. C.W. Bowman
(To July 13, 1984)

Mr. R.D. Humphreys
(From September 1, 1984)

Vice-Chairman
Mr. M.A. Carrigy

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Technical

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R.T. Bailey, P.Eng., Manager, Upgrading Projects
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T.J. Cyr, Manager, Technical Program Development
R.R. Germain, Project Engineer - Upgrading
C. Hsi, P.Eng., Manager, Institutional Research Programs
R.P. Padamsey, Process Engineer
G.H. Sayer, Project Engineer
A.C. Thakrar, Project Supervisor
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E.S. Tam, Reservoir Engineer
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D.L. Borhen, Receptionist
S.B. Jodoin, Secretary
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E.K. Spady, LL.B., General Counsel
B.J. Thom, Secretary
G.A. Villett, Registrar

Calgary
V.M. Foster, Clerk-Typist
M.H. Wagner, Secretary

* Resigned July 13, 1984

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J.B. Hyne, University of Calgary
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D.A. Redford, P.Eng., Manager, Technical Review
H.J. Ruitenbeek, Economic Evaluations
W. Vandenhengel, P.Eng., UMATAC Technical Committee
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1 In Situ Oil Sands Recovery Program

Petroleum Company Limited wet combustion pilot (Block 1) was located in the south Athabasca oil sands deposit. It was terminated in mid-1981. Petro-Canada Exploration Inc., Suncor Inc., and Shell Canada Resources Limited were also participants in this project.

An agreement between AOSTRA, Amoco, and Petro-Canada was signed early in 1984 to conduct a new pilot approximately 15 km NE of the Block 1 pilot using steam and steam plus additive processes.

The delineation wells for the new pilot have been drilled and tested to determine reservoir characteristics. The surface facilities are under construction and will be completed early in 1985. The remainder of the pilot wells will be drilled during mid-1985 and recovery operations commenced. The estimated cost is $22 million and the project will operate for three years.

1.2 AOSTRA-BP Marguerite Lake Pilot Project

The AOSTRA/BP Exploration Canada Limited project, located in the Clearwater sandstone of the Cold Lake oil sands deposit, is designed to test steam stimulation followed by wet combustion. Dome Petroleum Limited and PanCanadian Petroleum Limited are also participants in the project.

The project is now in its seventh year of operation and the initial steam stimulation phase is essentially complete. Concurrent special test wells of air injection confirmed the original plan to follow the steam stimulation phase with air injection to improve ultimate recovery. Feasibility studies led to a decision to use oxygen instead of air for the combustion phase.

Three wells in the main pattern have been converted to oxygen injection. This phase is planned to continue through 1985.

Four infill wells were drilled late in 1984 and are currently in their initial steam stimulation phase.

BP has been joined by Petro-Canada in a 1100 m³/d commercial project at Wolf Lake, surrounding the Marguerite Lake project, using project steam stimulation technology. The Wolf Lake project is under construction and initial production is expected in early 1985. AOSTRA is not a participant in the Wolf Lake project, but the technology developed at the Marguerite Lake pilot is being used in the project.

1.3 AOSTRA-BP B-Unit Pilot Project

AOSTRA, BP Exploration Canada Limited, and Petro-Canada Inc. are conducting a single-well cyclic steam stimulation project (B-Unit pilot) with two observation wells in the Lower Grand Rapids formation of the Cold Lake oil sands deposits. The object of the B-Unit pilot is to improve bitumen recovery by testing novel fracturing/injection methods which were developed at the AOSTRA-BP Marguerite Lake pilot, 10 km to the north. The producing zone is 16 m thick at a depth of 430 m. The third steam stimulation cycle will be completed by mid-1985 and additional cycles are planned, based on the encouraging results from the first three cycles.

The total cost of the project is estimated to be $4.2 million.

1.4 AOSTRA-SHELL Peace River Pilot Project

The AOSTRA-Shell Canada Resources Limited-Shell Explorer Limited Peace River Project, located 30 km NE of Peace River, was designed as a prototype installation. Amoco Canada Petroleum Company Limited is also a participant in this project.

At the pilot site, the oil sands are 550 m deep and 27 m thick. The oil sands deposit under the Shell lease fortunately has a bottom interval of high water saturation, averaging 3 m, which has provided an initial path for steam movement at the base of the reservoir.

The test is evaluating cyclic pressurization of the reservoir using steam. This process was extensively investigated by physical and mathematical simulation tests prior to the field tests.

Steam stimulation, the first pressurization cycle, and the first blowdown of the producing wells have been completed and approximately 16% of the original oil-in-place has been produced. The second pressurization and blowdown phase is now proceeding and is expected to be completed by early 1986.

A decision was made to obtain early production through single well cyclic steam stimulation and three new wells in a special area adjacent to the main pilot area were drilled for this purpose. The first cycle results are encouraging and additional cycles are planned for 1985. These results will provide information on the viability of cyclic steam stimulation as a precursor to the cyclic pressurization recovery process under development in the main pattern area.

The operator is now proceeding with the design of a commercial demonstration project with a capacity of 1600 m³/d. Initial production from the new project is expected in 1986. AOSTRA will not be a direct participant in the commercial project, but the existing pilot facilities and the associated technology will be incorporated into the new project.

1.5 AOSTRA-UNION Buffalo Creek and McLean Pilot Projects

Activity with Union Oil Company of Canada Limited and Canadian Superior Oil Limited to develop technology to produce the very large reserves of bitumen in the Devonian carbonate formations continued throughout the year.

This project is located in an isolated area approximately 100 km west of Fort McMurray, and tests since 1977 have been conducted in the Grosmont 2 formation to examine the suitability of steam stimulation, steam drive, and wet combustion processes.

Operations during the 1983-84 period continued through cycles 8 and 9 on a single-well steam stimulation test and cycle 10, plus other special tests for this well are planned for 1985.

A five-spot pattern (McLean pilot) was completed in 1983. The initial results indicated a geological anomaly within the pilot area. In order to maintain the initial pilot concept, two additional wells were drilled in early 1984 and operations have not been as successful as anticipated.

A cyclic steam test on a well in the original pilot area was initiated in the Grosmont 3 zone. A new single-well cyclic steam test will be conducted during 1985 at a location off-setting the current pilot area.

1.6 AOSTRA-CANTERRA-TENNECO Kearl Lake Pilot Project

This pilot is located 77 km NE of Fort McMurray, and is operated by Canterra Energy Limited. Tenneco Energy Ltd. is also a participant in this pilot. The pilot is testing a steam drive process in the McMurray sandstone which, in this area, is at a depth of 150 m and is about 43 m thick.

The pilot consists of two patterns: The "A" pattern is an inverted seven-spot with seven steam injection wells and six producers. The "B" pattern was drilled as an inverted five-spot with nine steam injection wells and four producers. Operations began in the "A" pattern in December 1981.

The results of the "A" pattern operation have been encouraging and are planned to continue throughout 1985. Based on the results of the "A" pattern, recovery operations commenced in the "B" pattern early in 1985. During 1984, four additional production wells were drilled in the "B" pattern to create an inverted nine-spot pattern.

1.7 AOSTRA-COLD LAKE-BOW VALLEY Pilot Project

As a result of an application from Cold Lake Heavy Oil Limited to carry out a steam plus additives test in the Cold Lake Clearwater oil sands reservoir, a preliminary laboratory and feasibility study was approved at a cost of $600,000.

This study was completed in March 1983 and a decision to perform a field test of the feasibility of producing from a low-grade reservoir with a high clay content was made in late 1983. Bow Valley Resource Industries Ltd. joined the project as operator on the pilot site which is located on a Gulf Canada Resources Inc. oil sands lease. Operations began in late 1984 and will run for two years at an estimated cost of $14,185,000. The project consists of an inverted seven-spot pattern.

1.8 AOSTRA-CHEVRON-CANADIAN OCCIDENTAL Algar Carbonate Pilot Project

A single-well, one cycle steam stimulation test was completed in the Grosmont carbonate, with Chevron Canada Resources Limited as operator, early in 1985. Canadian Occidental Petroleum Ltd. is also a participant in this test. The test is located 70 km SE of the Union Buffalo Creek pilot. The estimated cost of the test was $850,000, and the results are currently being evaluated, prior to consideration of further testing for the winter of 1985-86.

1.9 Electric Pre-Heat Studies

AOSTRA has supported activity in this area since 1977, through in-house and contracted studies aimed at investigating the use of electric preheating for the in situ production of bitumen. In 1984, AOSTRA purchased the results of a field test, using the electric heating concept, carried out by the PCEJ group in the south Athabasca pool. This data was reviewed and a proposal for further in-house studies, including a field test design, is under consideration.

1.10 Texaco Fort McMurray Horizontal Well Project

During 1984, AOSTRA concluded an agreement with Texaco Canada Resources Limited to acquire data on the three horizontal wells which Texaco had drilled and is operating in the Athabasca field near Fort McMurray. Future AOSTRA participation in new work on this project is being discussed with Texaco.

1.11 AOSTRA-Industry Mineralogical Transformation Study

AOSTRA is the operator in a cooperative industry-supported research program with eight other participants to conduct a state-of-the-art review of the available confidential and public information on mineralogical transformations during thermal recovery. RES-SEN Reservoir Technology Limited is the contractor conducting the review for the first phase of the study at a cost of $55,000. Further research will be considered upon completion of this review.

1.12 Data Base Management System

The AOSTRA Data Base System (ADBS) is a computerized data management system designed to store and disseminate operating data from in situ pilots, and is suitable for both thermal and non-thermal projects.

The ADBS storage format provides for extensive reporting in tabular and graphical format on both raw and processed data. Subject to confidentiality clearance on an individual project basis, direct access by computer terminals is available to users from both pilot sites and central office locations. The ADBS Command Language component can be used for "non-routine" access to data to support special engineering studies.

Enhancements to the system during 1984-85 included development of a microcomputer-based graphics package for generation of plots from data resident in the ADBS. The plot formats available are designed to illustrate in situ pilot performance.

The ADBS system software and data reside at the Canada Systems Group Service Bureau (CSG) in Calgary. Field data acquisition systems located at pilot sites can be easily linked to the ADBS to provide a smooth flow of data into individual project data bases.

AOSTRA staff provide full support to users of the system, including the initial set up of a project data base and ongoing operations support, as necessary.

During 1984-85, expenditures on the ADBS were $503,428 and revenues were $483,432 or 96% of expenditures. Cumulative expenditures to date are $2,415,642 and cumulative revenues to date are $1,624,359 or 67% of expenditures.

1.13 Computer Modeling

The agreement giving AOSTRA access to the Computer Modeling Group mathematical models continued.

Use of these models has provided AOSTRA staff with a useful tool to analyze the performance of ongoing pilot projects, and evaluate new proposals.

1.14 Economic Studies

During the year, H.J. Ruitenbeek Resource Consultants Limited was contracted to carry out studies on the commercial viability of two mature AOSTRA in situ projects, and one study which was used in evaluating a new in situ project.

In addition, the contractor was requested to develop the specifications for an economic model for internal AOSTRA use in evaluating and monitoring the commercial possibilities of new and existing in situ production projects.

2 Underground Access Program

supported various studies evaluating the shaft and tunnel access (SATAC) method of placing an array of horizontal wells low in the formation to promote recovery of bitumen from oil sands.In 1982, AOSTRA initiated a new study at a site, on Crown land, 17 km west of the Syncrude mining operations. Norwest Resource Consultants Limited of Calgary was commissioned to provide a design and cost estimate of an Underground Test Facility (UTF), which would provide access for underground thermal in situ recovery piloting. As a result of this study and previous work, AOSTRA dedicated $43 million to construct the first field stage of UTF.

This field project was started in 1984. After a review of the suitability of the Crown land site, further study and preliminary discussions with potential industry participants, AOSTRA contracted for the construction of two shafts and the initial tunnels. A 37 km access road to the site was completed during the year. Harrison Saturn Joint Venture was retained in July 1984 for the detailed engineering, procurement and construction of these facilities. Field work started at the site in November 1984 and is proceeding well. Drilling and lining of the first shaft is nearly completed. This phase of the project is scheduled for completion and commissioning by April 1986.

AOSTRA is continuing to develop, with industry, a preferred process for piloting from the UTF. Sixteen companies are represented on an industry steering committee working with an AOSTRA project team in process screening and project evaluation studies to identify the horizontal well process which should take priority in field testing. On the presently planned schedule, process pilot operations will begin early in 1987.

AOSTRA will also commission a drilling consultant to develop the necessary equipment and well drilling methods to accurately place horizontal wells in the reservoir from the underlying tunnel system.

3 Enhanced Recovery Program

Suffield Heavy Oil Pilot Project

This project, located in the Suffield military block in southern Alberta,is operated by Alberta Energy Company Limited (AEC) on behalf of AOSTRA, Dome Petroleum Limited, and Westcoast Petroleum Limited. The pilot is located in the glauconite sandstone and is testing a wet combustion process in a 19.5 m thick heavy oil reservoir underlain by water. The initial test pattern is an inverted five-spot covering two hectares.

Air injection into a central well commenced in February 1982 and water injection for the wet combustion phase began in early 1983.

Production to date has been significantly greater than would have been achieved under primary production. One encouraging result is that water coning, typical of wells in this field, is not yet evident in the pilot wells.

The project is scheduled to continue through 1985.

3.2 AOSTRA-VIKOR RESOURCES Joffre Viking CO_2 Miscible Pilot

This pilot, located in the abandoned Joffre Viking pool in central Alberta, is operated by Vikor Resources Limited on behalf of AOSTRA and the unit participants. It is located in a lower Cretaceous (Viking) sandstone reservoir and is testing the ability of a CO_2 miscible flood to recover tertiary oil from a 3 m thick, light gravity, oil reservoir which had previously been waterflooded. The initial pilot consists of two five-spot patterns, each covering 160 acres.

Carbon dioxide injection into one of the patterns commenced in January 1984, and into the second pattern in July 1984. Carbon dioxide injection is planned to continue for three years. Water injection is being alternated with CO_2 injection (WAG process) for fluid mobility control. Production response to CO_2 injection was evident during 1984.

The gross cost of the project is estimated to be $22 million and it is planned to operate through 1988. Results to date have been very encouraging and the unit owners are planning a commercial expansion which is expected to be in operation late in 1985.

3.3 AOSTRA-PETRO-CANADA Viking-Kinsella Pilot Project

This project was originally intended to compare combustion and steam flood performance in a thin (4 m) Lloydminster-type heavy oil reservoir. The steam pattern was suspended at the end of 1981 due to generally unsatisfactory performance. Drilling of three new production wells within the air pattern in 1982 changed its configuration to two inverted five-spots on a reduced well spacing. Wet combustion commenced in mid-1983.

Air injection was increased substantially in early 1984 and showed immediate response with increased oil production. However, hot well operation problems coupled with declining oil production led to a decision to terminate the pilot at the end of 1984. The reservoir will be depressured and the wells abandoned during 1985. A full analysis and final reporting of pilot data will be conducted during 1985.

3.4 AOSTRA-HUDSON'S BAY (DOME) Caustic Flood Test

Tracer tests were conducted on two wells in the Basal Colorado "A" pool by Hudson's Bay Oil and Gas Company Limited in mid-1980 to evaluate this pool as a candidate for caustic waterflooding. The tests determined that the technique was effective for measuring residual oil saturations after a caustic flood. AOSTRA acquired the results of the tests in June 1981.

Hudson's Bay has commenced a caustic/polymer test in the field and an agreement for AOSTRA participation in this test is now being negotiated.

3.5 Heavy Oil Lifting Project

From its inception in 1979, this program has investigated, evaluated, and tested heavy oil pumping systems and related parameters. Each phase of the program was directed by an industry consortium with work activities performed by Calgary-based Pengalta Research and Development Limited.

Three promising pump designs from Phase I and II were modified for testing in Phases IIIA and IIIB. As a result of the Phase IIIA testing, negotiations for commercial manufacture of the Mark III tubing pump are presently underway. In Phase IIIB, two styles of hydraulically driven downhole pumps were modified from their corresponding Phase II predecessors. Results of the just completed Phase IIIB testing were disappointing due to mechanical problems in the pumps.

Total cost of this work to date is $2,135,000. AOSTRA's share is $187,100.

3.6 AOSTRA-NORCEN Bodo Field Pilot

This joint project of AOSTRA and Norcen Energy Resources Limited involved laboratory studies on a comparison of steam flooding versus combustion in the Bodo field. This is a low gravity pool (13.5° API) located in east central Alberta producing from the Mannville "B" sandstone at a depth of approximately 735 m. Norcen's partners in this project include Canadian Reserve Oil and Gas Ltd., Murphy Oil Company Ltd., and Canadian Occidental Petroleum Limited.

The results of the laboratory study were encouraging and AOSTRA, Norcen, and partners are proceeding with a nine-spot steam pilot off-setting the combustion operations in the Bodo field. Drilling of the pilot wells began in late 1984 and production operations will begin mid-1985.

3.7 AOSTRA-PANCANADIAN Countess "B" Combustion Project

AOSTRA, PanCanadian Petroleum Limited, and LL&E Canada Limited have agreed to cooperate in a Countess "B" pilot, located 20 km west of Brooks, Alberta. The pilot, consisting of a 16 ha inverted five-spot pattern and associated surface facilities, is designed to evaluate a wet combustion recovery process in the waterflooded Countess Upper Mannville "B" pool. This pool contains medium-gravity oil of 28° API at a depth of 1066 m with a pay thickness of 7.6 m.

PanCanadian is operating and financing the field pilot with LL&E. AOSTRA is funding a research program to support the pilot activities, with the field and research results being shared among the parties. AOSTRA is the owner of, and licensing agent for, the technology being developed, both in the field and in the laboratory.

Pilot operations were encouraging during 1984 and will continue through 1985. The research program included coring of a well to evaluate the efficiency of the reservoir combustion recovery operation.

3.8 Emulsion Treating Study

Pengalta Research and Development Limited was contracted by a consortium of six industry companies and AOSTRA in February 1984 to perform a state-of-the-art review of emulsion treating primarily from an equipment viewpoint. The resulting study will serve as a basis for additional developments and is being actively marketed. Cost of the study was $99,000, of which AOSTRA's share was $45,000.

4 Produced Water Recycling Program

The necessity to treat water produced from steam-assisted in situ bitumen recovery operations, combined with the limited supply of fresh waters in the heavy oil regions of Alberta, are indicative of the need for the development of a specialized water treatment technology. The AOSTRA/Industry Produced Water Treatment Project was initiated to evaluate and select the most economically and technically suitable water treatment systems for upgrading produced waters to boiler feedwater qualities.

With the conclusion of Phase III of the project, the detailed evaluation of both conventional and unconventional water treatment systems has been completed. The most promising technologies have been identified and a program has been developed (Phase IV) to field test these processes so as to verify the assumptions used in the detailed evaluation. The proposed Phase IV would cost approximately $2 million and see the construction and operation of both field and lab bench-scale test facilities. AOSTRA has indicated its willingness to assume 50% of the Phase IV costs and is now seeking industry participation.

4.2 Brackish Water Treatment System

Hankin Environmental Systems Incorporated (formerly Francis Hankin and Company Limited) responded to an AOSTRA invitation for applications in the field of treatment of water produced from steam-assisted in situ bitumen recovery processes. Hankin owns a patented water treatment process which includes, among other things, dissolved air flotation, activated carbon adsorption, and electrodialysis. A field bench-scale test of the Hankin system was performed on produced water from the AOSTRA/Shell Peace River in situ pilot plant in 1983 (at a total project cost of $432,000). The final report was received in the summer of 1984.

AOSTRA is currently evaluating the incentives for carrying out additional research to advance the development of this technology.

5 Surface Mining Extraction Program

The Taciuk Process is a dry retorting process developed for the recovery of hydrocarbons from mined oil sands. Retorting of bitumen from oil sands and burning of deposited coke are combined in a horizontal rotating vessel.

The process has been under development since 1977 by UMATAC Industrial Processes, a Division of UMA Engineering Ltd., with AOSTRA funding. A pilot plant, constructed in Calgary in 1978, has processed in excess of 11,000 tonnes of oil sands. Process concepts have been demonstrated and investigation of process parameters, and development of design correlations have been attained through continuous operation of the pilot plant over extended periods.

In late 1982, the first phase of a program leading to a large scale demonstration of the process was initiated. During this phase, the preliminary engineering design, and capital and operating cost estimates for a 90 tonne per hour demonstration facility were prepared. A technical and economic study of commercial-scale projects, comparing the Taciuk Processor with a project using Hot Water Extraction and Flexicoking, indicated an economic advantage for the Taciuk Process.

AOSTRA is currently seeking third party participation for the large-scale demonstration of the processor. The total cost for the pilot plant program and the first phase of the demonstration program was $11,730,000.

In 1984, the Taciuk Process was successfully tested on oil sands from the Bemolanga deposit in Madagascar. The Office Militaire National Pour les Industries Strategiques (OMNIS), a Malagassy Democratic Republic organization responsible for petroleum research and development, collected and shipped a 550 tonne oil sands sample to UMATAC. Results obtained from the pilot plant tests have been reported to OMNIS. The cost of the test ($240,000) was funded by AOSTRA.

5.2 INPROTAR MEP-1001 Extraction Process

Inpro Engineering Limited has developed a bitumen extraction process based on the principle of gentle slurrying of bitumen with hot water. The purpose of the gentle slurrying is to minimize the formation of emulsions, and thereby improve the bitumen separation and recovery. Fabrication of a 100 kg/h test facility is essentially complete, with debugging runs underway. AOSTRA has committed a total of $162,000 to the project. The final report is expected by the end of May 1985.

5.3 Basic Research on Direct Oil Sand Retorting

In the fall of 1984, Nova-Husky Research Corporation completed a series of experimental tests to determine the effect of water and calcium addition and varying heating rates on hydrocarbon yield and sulfur emissions from the direct retorting of oil sands. The $180,000 project was funded two-thirds by AOSTRA and one-third by Canstar Oil Sands Ltd. A final report has been issued and, based on some of the more promising results obtained from the study, additional work is being contemplated.

5.4 Oleophilic Sieve Development Company of Canada Limited Project

The Oleophilic Sieve Development Company of Canada Limited is working with Suncor Inc. and AOSTRA to test the effectiveness of the oleophilic sieve process (the Kruyer process) for the recovery of hydrocarbons from effluents produced by the hot water extraction of bitumen from oil sands.

The Kruyer process is a novel extraction concept whereby agglomerated bitumen is captured on the coated surface of a perforated continuous belt, while water and solids are allowed to pass through belt openings. The program presently underway consists of engineering, procurement, construction, and performance testing of a one tonne/hour continuous flow laboratory-scale pilot plant, in Edmonton.

The $820,000 project is being funded on a 75 - 25% basis by AOSTRA and Suncor, respectively. Completion of the project is expected by the summer of 1985.

5.5 Proposed Oil Sands Demonstration Center

To facilitate the testing of new oil sands mining and extraction technologies, AOSTRA, the Federal Department of Energy, Mines, and Resources, and a number of companies holding mineable oil sands leases, have joined together to investigate the feasibility of constructing an Oil Sands Demonstration Center (OSDC) in the Fort McMurray area of Alberta. The Center would be a cooperative, shared-cost facility able to accommodate large-scale, long-term testing of new technologies which would be applicable to mined oil sands. The purpose of the OSDC would be to provide the necessary utilities and infrastructures which are essential for the field demonstration of the technical and economic viability of new equipment and processes on a semi-commercial scale. These services would be provided to developers of new technologies on a fee-for-service basis. Phase III of the project, including site selection, scope finalization, design and costing, preliminary negotiations for agreements and contracts, and support facilities studies, has been completed at a cost of $500,000.

Construction of the OSDC is estimated to cost $23.4 million. The future of the OSDC is now dependent on the confirmation of future users, and the definition of incentives for industrial participation in the OSDC.

6 Upgrading Program

Demonstration Project

In late 1983, AOSTRA, a group of industrial companies, and the Federal Department of Energy, Mines, and Resources initiated the Upgrader Demonstration Project. The intent was to demonstrate the performance and operability of selected bitumen or heavy oil upgrading processes, with a view to establishing their commercial application for upgrading plants in Alberta.

This demonstration project is one of two AOSTRA projects arising from the $3.5 million Heavy Oil and Bitumen Upgrading Study. The study concluded that there are upgrading processes available which show advantages over processes which are currently in use in commercial oil sands projects. However, the demonstration of these upgrading processes is required before they can be accepted by industry for use in commercial upgrading projects.

Phase I was completed early in 1985, at a final cost of $119,375. The Phase I recommendations include carrying out feed tests with both Athabasca and Cold Lake bitumens, with up to three selected upgrading processes.

Phase II was initiated in February 1985 and is expected to be complete by early in the third quarter of 1985. Eleven participants are equally sharing 50% of the $82,000 Phase II cost, and AOSTRA is paying the balance. This second phase will provide a precise definition of the recommended feed tests, as well as determination of the costs and other necessary support preparations.

The decision to proceed with one or more feed tests in a third phase of the project will be made by AOSTRA and industry on the basis of the results of Phase II. Continued industry support is essential to the initiation of Phase III.

6.2 AOSTRA-Industry Upgrading Residue Utilization Project

All processes designed for the upgrading of bitumens and heavy oils produce residues which must be utilized in an environmentally acceptable and economically feasible manner.

The AOSTRA-Industry Upgrading Residue Utilization Study was initiated late in 1982, and presently includes AOSTRA, the Federal Department of Energy, Mines, and Resources, and eight industrial companies. The study's objective is to identify, evaluate, and eventually test the most promising technologies for the utilization of upgrading residues.

Phase II of the project, which is due to be completed by the end of 1985, is designed to evaluate, technically and economically, utilization technologies which were selected by AOSTRA and the industrial participants in the initial phase of the project.

AOSTRA is committed to 50% of the estimated $2 million Phase II budget. The other companies are sharing equally the remaining 50% of the project costs.

6.3 AOSTRA-Gulf Canada Resources Inc. Project

The Donor Refined Bitumen (DRB) Process, is an upgrading process based on low pressure, non-catalytic, thermal hydrocracking in the presence of a hydrogen donor solvent. The process was developed by Gulf Canada Resources Inc., and offers the potential of lower costs, simplicity, and improved operability over current commercial upgrading processes.

To date, AOSTRA has funded 50% of the $3.15 million spent on pilot plant research in Phases I and II. Results from this research and testing indicate that high liquid yields are possible from the DRB process, and that the economics of the process appear to be attractive.

Based on the success in process development, AOSTRA has approved a $10.8 million application for a semi-commercial scale demonstration of the DRB process at the ASVAHL experimental refinery in Lyon, France. Preliminary work and the negotiation of a project agreement are now underway.

6.4 Lloydminster Area Processing Study

In late 1984, AOSTRA joined Phase I of a multi-participant project, called the Lloydminster Area Processing Study. The project was initiated by Murphy Oil Limited to investigate the options for the continued production and transportation of Lloydminster heavy crude.

The objectives of the first phase of the study include: undertaking and evaluating pilot plant work done by Institut Francais du Petrol (IFP), on a hydrovisbreaking process to upgrade Lloydminster heavy oil to pipeline viscosity specifications; and a preliminary examination of alternatives to heavy oil upgrading.

Phase I was completed in late 1984, for a cost of approximately $296,000, shared by 13 participants.

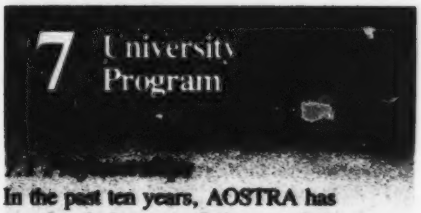
The $200,000 second phase, which is now underway, will review heavy oil and condensate supply/demand trends, and alternatives to upgrading for diluent supply, which will allow for continued transportation and marketing of heavy oil.

6.5 Bitumen/Water Transportation Study

In the fall of 1984, AOSTRA and several organizations representing industry and the federal government initiated a project to evaluate the pipeline transportation of mixtures of bitumen and water.

Phase I of the project will examine the concept of a bitumen/water transportation system, with preliminary analysis of the system(s) for feasibility, practicality, and economy. Late in Phase I, the planning and costing of further phases, if warranted, will be undertaken, and participants in the project will elect whether or not to continue with the project.

The project is presently being carried out with all parties sharing equally in the $80,000 Phase I costs. Phase I completion is expected in the summer of 1985.



In the past ten years, AOSTRA has appointed eleven professors to chairs at Alberta universities to carry out advanced research on oil sands problems. The term of each initial appointment is three years renewable for a further term of two years. The incumbent professors may also apply for additional funds for specific research projects.

The current incumbents are involved in the following research projects:

i) Dr. L.G. Hepler of the University of Alberta is continuing his investigation of clay/oil/water systems encountered in many aspects of the oil sands industry and is also measuring specific heats of various components of oil sands and heavy oil deposits.

ii) Dr. E.C. Pielou of the University of Lethbridge will continue investigating the impact of oil sands development on the environment. Studies will be conducted in the areas of reclamation and pollution.

iii) Dr. J.D. Scott will continue the use of analytical modeling techniques and laboratory and field experimental studies to increase basic knowledge of the geotechnical properties of oil sands.

iv) Dr. T.J.T. Spanos is beginning the two-year renewal of his professorship at the University of Alberta and will continue the mathematical simulation of in situ recovery processes with emphasis on the fundamental equations that describe the dynamics of fluid flow and displacement.

v) Dr. O.P. Strausz of the University of Alberta is continuing the investigation of the chemistry of Alberta oil sands bitumens, with particular emphasis on the heavier fractions.

vi) Dr. E.L. Tollefson of the University of Calgary continues the investigation of desulfurization of coke and the relative fuel values of some constituents of oil sands.

These professors devote approximately three-fourths of their time to oil sands research. The total funds committed to date for the professorship program is $2.9 million.

7.2 Graduate Scholarships and Fellowships

Post-graduate scholarships and fellowships have been made available over a nine-year period for oil sands research at the University of Alberta, the University of Calgary, and the University of Lethbridge. Current award holders are identified in the following lists. The scholarships are for a maximum period of two years and the research carried out will normally lead to either a Masters or Doctoral degree. Fellowships are intended to assist post-doctoral scientists in furthering their research training. Many of these individuals will eventually enter the industrial research sphere.

University of Alberta

Branco, P.
Decker, R.M.
Dimitrakopoulos, R.G.
Heibert, A.D.
Kasperski, K.L.
Khorasheh, F.
Kosar, K.M.
Lam, W.*
McIntyre, D.D.*
Novar, A.
Peacock, D.
Plewes, H.D.
Proctor, M.L.
Semple, K.M.
Seto, A.C.
Singh, R.*
Spence, J.R.
Sutherland, F.M.
Tortike, W.S.
Triet, J.D.
Wong, R.C.

University of Calgary

Belgrave, J.D.M.
Calverley, E.A.
Johnson, S.E.
MacLeod, F.A.
McKinley, V.L.
Sibbald, L.R.
Yee, C.T.

* Fellowship

7.3 University Research Projects

AOSTRA continues to support various oil sands and heavy oil-related research projects at Canadian universities. The university research program covers many areas of interest ranging from fundamental research in the basic science of bitumen and heavy oil to applied research in bitumen recovery and upgrading technologies. The budget in 1984/85 for support of research in Canadian universities amounted to approximately $3.5 million. Brief descriptions of the projects carried out in 1984-85 follow:

1. Dr. H. Alper of the University of Ottawa was awarded $68,070 to conduct a two-year research program which is aimed at developing new, mild, and economical methods for extraction of sulfur from bitumen.

2. Dr. F.W. Bachelor of the University of Calgary is continuing the investigation of nitrogen and oxygen-containing compounds in bitumen. This research has a cumulative funding of $414,503.

3. Dr. M.H.I. Baird of McMaster University is developing and testing laboratory techniques involving bitumen/aqueous flow in cylindrical tubes. The results of this study will provide insights into how bitumen is displaced from oil sands. A total of $50,374 over 18 months was awarded to Dr. Baird for this study.

4. Dr. D.W. Bennion and Dr. R.G. Moore at the University of Calgary are continuing their extensive investigation of the combustion of oil sands and the low temperature oxidation of bitumen. These researchers have been funded over a period of nine years to a total of $1.5 million.

5. Dr. N. Berkowitz of the University of Alberta is studying the extraction of bitumen from oil sands by using super-critical gas in H-donor systems. This project will receive $96,740 over a two-year period.

6. Dr. P.M. Boorman and colleagues at the University of Calgary have been investigating the catalytic desulfurization of bitumen since 1976. A total of $500,031 has been awarded to Dr. Boorman for this work.

7. Dr. R.M. Butler of the University of Calgary is investigating heat and mass transfer mechanisms during the in situ recovery process. Dr. Butler has been awarded $150,000 for this research for a one-year period.

8. Dr. P.M. Byrne of the University of British Columbia has been working on a method for predicting stress-strain relationship and deformation analysis of oil sands. A total of $58,588 has been made available for this project over a period of three years.

9. Dr. R.G. Cavell of the University of Alberta is applying Secondary Ion Mass Spectrometry (SIMS) to study the interaction of polar organic and inorganic molecules with mineral surfaces. A total of $151,410 was awarded to Dr. R.G. Cavell for the three-year study.

10. Dr. F.S. Chute and Dr. F.E Vermeulen of the University of Alberta have been measuring electrical properties of oil sands, developing physical models of electrical heating methods, and evaluating the use of electrical power for selective heating of oil sands. Their research has been funded for $369,513 over a seven-year period.

11. Dr. D.E. Cormack of the University of Toronto continues to carry out research which was started by Dr. P.C. Stangeby, also of the University of Toronto. He is studying two-stage pyrolysis procedures for upgrading bitumen. This one-year continuation will cost $65,221.

12. Dr. J.W. Costerton at the University of Calgary is investigating the control of bacterial plugging during water or polymer flooding operations. This research has received support of $207,000 over a two-year period.

13. Dr. I.G. Dalla Lana and Dr. M.R. Gray of the University of Alberta have been awarded $150,000 for a two-year study to characterize the reactive chemical structures in bitumens and gas oils for kinetic modeling.

14. Dr. F.A.L. Dullien of the University of Waterloo is studying the pore structure, rock-fluid interaction, and two-phase flow behavior of Pembina Cardium "B" pool thief zone. This is a two-year project costing $47,492.

15. Dr. M.B. Dusseault of the University of Waterloo is carrying out a preliminary research for modeling in situ geomechanics of oil sands. This short-term project will cost $10,000.

16. Dr. S.M. Farouq-Ali of the University of Alberta has been investigating the effect of diffusion and gravitational forces on the recovery of heavy oil when using the carbon dioxide slug process. This project has been funded to a total of $446,310 over three years. Another $105,000 has been made available to Dr. Farouq-Ali for preliminary research on the development of methods of mobility control.

17. Dr. D.L. Flock, of the University of Alberta, is studying the effects of additives in steam on the degree of emulsification of oil in water and the relationships of these effects to overall recovery by cyclic steam stimulation and steam displacement. This is a three-year project costing a total of $300,000. Another $56,824 was awarded to Dr. Flock to study the temperature and pressure effects on crude oil recovery from bituminous carbonates.

18. Dr. J.E. Gillott of the University of Calgary has been investigating the changes in strength, dimensions, permeability, and bond characteristics of oil well cements after hydrothermal treatment in the presence of formation fluids and drilling muds. This research has been funded to a total of $203,349 since 1982.

19. Dr. L.G. Hepler at the University of Alberta has been doing research on colloidal and thermodynamic properties of various clay, oil, and water systems for many years and is also measuring specific heats of minerals and oils from several oil sands and heavy oil deposits. Funding has amounted to $565,244 over nine years.

20. Dr. T.R. Hsu of the University of Manitoba is developing an industrial application-oriented computer program to describe the in situ fracturing behavior of oil sands formations, subject to optimum combinations of controlled impulse and/or hydraulic loadings. This project will cost $196,300 over three years.

21. Dr. I.E. Hutcheon at the University of Calgary is investigating rock-oil-water interactions in heavy oil systems, with particular emphasis on the carbonate deposit. This five-year project will cost $398,850.

22. Dr. J.B. Hyne of the University of Calgary has been studying the reactions of bitumen, emphasizing sulfur-containing compounds, at temperatures and pressures comparable to in situ recovery conditions. Petro-Canada Inc. and INTEVEP of Venezuela have purchased access to this program by paying 25% and 50%, respectively, of the cost and are participating in technical planning. AOSTRA's contributions to this project have amounted to $1,106,621 over a seven- year period.

23. Dr. F.W. Jones and Dr. J.S. Rogers of the University of Alberta are working on the development and application of an improved tiltmeter. This instrument is potentially useful for following the progress of earth movements above in situ recovery processes. This three-year project will cost $215,435.

24. Dr. N. Kosaric of the University of Western Ontario has been investigating the use of bacteria and bacterial products for breaking emulsions that are formed during production of bitumen and heavy oils, at a cost of $76,147 over 13 months. On January 1, 1984, an additional $51,790 was made available to Dr. Kosaric for further study and evaluation.

25. Dr. H.R. Krouse of the University of Calgary is directing a program designed to provide gas chromatographic/stable isotope analyses for monitoring progress of in situ combustion processes. Total funding has been $412,800 over a seven-year period.

26. Dr. R. St J. Lambert at the University of Alberta has been provided with $78,260 for two years to study the tectonic setting and history of the Cretaceous rocks in the western Canadian sedimentary basin.

27. Dr. S. Levine and Dr. B.D. Bowen from the University of British Columbia have been awarded a total of $73,024 for a one-year study on the stabilization of emulsions by fine particles.

28. Dr. B.C.Y. Lu of the University of Ottawa is examining the internal consistency of the existing data on gas solubilities in bitumen which are available to AOSTRA. He is also investigating the applicability of various equations of state which could lead to a simpler method for simulating reservoir performance. This project will cost $51,100 over a two-year period.

29. Dr. A. Meisen of the University of British Columbia has been examining the possibility of using fluids such as carbon dioxide, ethane, and propane, in the supercritical state, for the extraction of bitumen. This one-year project, which will yield fundamental information on equilibrium solubilities as well as extraction rates, will cost $43,000.

30. Dr. N.R. Morgenstern and Dr. J.D. Scott of the University of Alberta have designed and set up a high temperature, high pressure facility and are using the facility to measure strengths, deformabilities, and permeabilities of oil sands at temperatures and pressures encountered in in situ production. This work has been funded to a total of $433,787 over a five-year period.

31. Dr. E.W. Neumann of the University of Toronto has developed a new method for investigating surface thermodynamic properties, such as surface tension of bitumen obtained from different extractions of oil sands of different origins and grades. Funding of this research has been $240,479 over four years.

32. Dr. E. Nyland of the University of Alberta is developing and testing a field-oriented microseismic monitoring array for remote monitoring the progress of oil sands and heavy oil in situ recovery processes. This project will cost $282,300 over a two-year period. A further $96,564 was made available to Dr. Nyland and Dr. M.B. Dusseault of the University of Waterloo to refine a prototype observing system for microseismic events related to enhanced recovery projects.

33. Dr. F.D. Otto, Dr. I.G. Dalla Lana, and Dr. S.E. Wanke of the University of Alberta are characterizing and evaluating the performance of catalysts for the hydroprocessing of heavy oil from Alberta reservoirs. The two-year project is funded for $252,877.

34. Dr. H. Pascal, at the University of Alberta, studied the displacement mechanism of heavy oil by water in capillaries. This study was funded for $72,600 for one year.

35. Mr. E. Peake of the Kananaskis Center for Environmental Research at the University of Calgary is assessing the environmental hazards and human health risks that might arise from toxic and carcinogenic compounds that could be generated during in situ fireflood production from oil sands. Funding for this project has been $217,000 over two years, with some costs shared equally between AOSTRA and the Alberta Department of Environment.

36. Dr. L.W. Reeves of the University of Waterloo is investigating the use of Nuclear Magnetic Resonance (NMR) for studies of properties of oil sands and derived bitumen. This project will cost $30,000 for two years.

37. Dr. R.S. Roche of the University of Calgary is investigating the kinetics of the pyrolysis of bitumen. The chemistry of the thermo-oxidative changes in asphaltenes and other components of bitumen are being studied by non-isothermal programmed pyrolysis-mass spectrometry (NIPPY-MSI). This project was funded for $778,647 over eight years. A further $132,084 was awarded to Dr. Roche to continue the research for another year.

38. Dr. J.D. Scott of the University of Alberta was awarded an amount of $90,000 to build an apparatus for measuring the thermal and seismic properties of oil sands.

39. Dr. D.G. Smith of the University of Calgary has received funds of $37,229 for a year's study of the variations in continuity and thickness of modern analogues of the epsilon mud beds in the McMurray formation.

40. Dr. T.S. Sorenson of the University of Calgary evaluated the possibility of catalytic hydrocracking of raw bitumen in a single upgrading step. Transition-metal catalysts supported on ϒ-alumina were being evaluated and compared under various conditions of temperature and pressure. This project was funded for $252,378 over four years.

41. Dr. T.J.T. Spanos of the University of Alberta is investigating mathematical analyses of fluid-flow behavior in relation to in situ production. This research will cost $189,799 over a four and one-half year period.

42. Dr. P.C. Stangeby of the University of Toronto studied the use of a rapid-heating hydropyrolysis procedure for upgrading bitumen. This five-year project costs $228,316 and has been continued under Dr. D.E. Cormack's supervision (see item 11).

43. Dr. O.P. Strausz and Dr. D.S. Montgomery at the University of Alberta have been conducting several continuing research projects involving different aspects of the chemistry of bitumen. One project is a detailed investigation of the asphaltene and resin fractions of bitumen. A second project is to investigate electron paramagnetic resonance as a diagnostic tool for studying polymer coke and formation in Alberta heavy oil. Another newly added project is to characterize olefins present in Athabasca bitumen and the Cretaceous heavy oils of Alberta. Total funds spent and committed in the period of 1977—1987 amount to $2,505,184.

44. Dr. W.Y. Svrcek and Dr. A.K. Mehrotra of the University of Calgary have been measuring the solubilities of gases in bitumen and the viscosities of the resulting gas-bitumen solutions. Total funding has been $490,660 over a period of six years.

45. Dr. E.L. Tollefson of the University of Calgary has been investigating the technology and economics of desulfurizing the coke produced from bitumen upgrading operations. Funding for this research has been $389,666 over a period of four years. In addition, $25,000 has been provided to Dr. Tollefson to conduct exploratory research on the recovery of hydrocarbons from waste tailings of the hot water process.

46. Dr. R.C. Von Borstel of the University of Alberta directs an evaluation of the possible mutagenicity of various process streams from in situ pilot projects and bitumen upgrading operations. This project has been funded at $325,693 over four years.

47. Dr. J.K.S. Wan of Queen's University is investigating the use of microwave induced catalysis in various hydrocracking processes for upgrading bitumen. Total funding is $234,040 for three and one-half years.

48. Dr. N.C. Wardlaw of the University of Calgary is investigating rock-pore properties in carbonate and sandstone reservoirs in relation to enhanced oil recovery. This project is funded with $367,384 over a four-year period.

8 AOSTRA-Alberta Research Council Program

AOSTRA continues to support several major programs at the Alberta Research Council (ARC). These programs are described below.

8.1 Oil Sands Laboratory Research

This is the fourth year of the five-year agreement into which AOSTRA and ARC entered to conduct a joint research program at the ARC's Oil Sands Research Laboratories with the aim of developing economically viable steam-based thermal in situ recovery processes through an integrated and balanced laboratory research plan. In 1984/85, a total of $5.25 million was expended for the program. AOSTRA contributed 60% ($3.15 million) of the total cost and ARC the remainder.

Because of the general interest on the part of industry in developing the Cold Lake oil sands, a substantial effort is now being devoted to the research on this deposit. Some notable accomplishments achieved during the year are as follows:

a) Promising recovery processes under Cold Lake reservoir conditions using steam, and steam plus carbon dioxide have been identified. It has been observed, however, that carbon dioxide as a steam additive did not yield the same improvement in recovery when dissolved gases, such as methane, were present in the Cold Lake bitumen. Therefore, gas additive processes may have limited application to the Cold Lake deposits.

b) The effect of dissolved methane gas in the Cold Lake oil sands was, for the first time, studied by numerical modeling methods.

c) Significant progress has been made in understanding and interpreting surfactant actions in steam-based processes. Experimental observations in conjunction with numerical modeling studies of flow behavior of steam-water mixtures under various conditions, showed that formation of a steam-foam is likely the mechanism to explain the high bitumen recovery obtained in steam-surfactant processes.

d) Injection strategies for production of foams in the field were also developed as a result of laboratory studies on foam generation, foam stability, and foam flow behavior.

e) The relative amount of oil and water in an oil sands formation was studied in order to understand better the flow of multiphase fluids through the formation during a given recovery process experiment. The technology of Computerized Axial Tomography (CAT), as used in the medical field, has been modified to meet the need to observe the flow of oil and water three-dimensionally. Researchers may also adapt this technology to study the water/oil interfacial activities.

f) Wellhead sampling techniques were developed for collecting water samples to compare what is injected with what is recovered. In this way, mineral transformation in the formation can be monitored. By using this data, researchers can predict the reactions taking place in the formation. Pilot plant operators can also adjust recovery processes accordingly to prevent undesirable mineral transformations.

8.2 Sample Bank

A new three-year agreement was entered into with ARC to continue the operation of the Sample Bank. Under the new arrangement, AOSTRA has agreed to support up to 2.4 person years for each year of the next three years, with the first year's (1984/85) budget being $175,000. The Sample Bank will maintain its prime function of providing "standard" oil sands, bitumen, and other related samples to research workers around the world. In 1984/85, the Sample Bank shipped 189 samples (approximately 67 tonnes).

8.3 Geology

AOSTRA and ARC entered into an agreement to jointly fund a project to continue the regional geological work from April 1, 1984 to September 30, 1985. The total cost of carrying out the 18-month project amounts to $1,333,333, of which AOSTRA will pay 60% and ARC the remainder. The project activities include the finalization of geological studies of the following deposits: Athabasca North, Peace River, Wabasca (Grand Rapids formation), and the Grosmont formation. These studies include research on

(a) facies and depositional environments,
(b) reservoir petrology and diagenesis, and
(c) deposit mapping for reservoir evaluation and technology transferability.

In addition, approximately 1.0 man year and 0.75 technical man years were provided for site-specific studies and membership on the technical committees of each AOSTRA field pilot.

8.4 Oil Sands Information Center

During the final year of a five-year agreement, AOSTRA provided $480,750 to ARC to continue the operation of the Alberta Oil Sands Information Center (AOSIC). AOSIC collects and disseminates information related to oil sands, heavy oil, and enhanced oil recovery.

In addition to publishing the Alberta Oil Sands Index (AOSI) and the Heavy Oil/Enhanced Recovery Index (HERI), AOSIC provides on-line access to both computerized AOSI and HERI data bases. AOSIC, on behalf of AOSTRA, also publishes and distributes a newsletter entitled the "Tar Paper" to interested people in the petroleum industry.

8.5 Hydrocarbon Upgrading Project

The objective of this program is to develop research capability in Alberta on upgrading of bitumen and to do bench-scale and pilot-scale experiments that develop promising processes discovered in other AOSTRA-supported research. The budget supported equally by AOSTRA and the Alberta Research Council is $1.5 million per year for three years starting June 1984.

The program has started three projects that have the following near-term objectives:

1. Evaluation of a two-stage bitumen/coal co-processing scheme for upgrading of bitumen. Experiments in which a mixture of carbon monoxide and steam was added in the first stage of the process showed results that were encouraging. However, economic analysis of the results as applied to a conceptual design of the process showed it to be no better than existing processes. In May 1985, pilot-scale experiments of a one-stage co-processing scheme began.

2. Evaluation of coker feedstock additives. Heterogeneous and homogeneous catalysts are being tested in a bench-scale pilot coker to select promising catalysts. Results using lime as an additive appear encouraging.

3. Evaluation of superacidic catalysts for upgrading of bitumen and vacuum residues. ARC has demonstrated it is capable of preparing heterogeneous catalysts that have activities and other characteristics similar to the best commercially available catalysts. Novel inexpensive hydrocracking catalysts prepared from locally available materials are being tested.

9 Programs at Other Research Institutes

Until 1985, Alberta Energy and Natural Resources provided grants to PRI equal to industry membership fees. AOSTRA assumed this obligation in 1983 and has continued it since. These funds are used for carrying out basic research in EOR methods applicable in Alberta, primarily in heavy oil and conventional light oil pools.

In 1984, the AOSTRA grant provided approximately 30% of PRI's total budget. Due to a major reduction in contract research work available to PRI, primarily from Federal Government agencies, it was necessary for PRI to restructure the industrial membership fee schedule at the end of 1984. This will have the effect of increasing the industry membership fees and also the AOSTRA grant to approximately 45% of the total PRI budget. No contract research work was done for AOSTRA at PRI during 1984.

9.2 British Columbia Cancer Foundation Program

AOSTRA provided the Carcinogen Testing Laboratory of the British Columbia Cancer Foundation with $125,000 over a two-year period to evaluate the use of mammalian cells in genotoxicity testing of oil sands process streams and related materials. Samples were collected from various AOSTRA-supported pilot projects and assayed for their capacity to induce chromosome and DNA damage in Chinese hamsters ovary cells and human skin fibroblasts, respectively. The entire study is aimed at developing a relevant system for making human carcinogen risk assessments. The results are being interpreted and the final report will be completed during the coming year.

9.3 Syncrude Canada Limited

AOSTRA and Syncrude Canada Limited have agreed to jointly fund a research project to develop a computerized regional Air Quality Prediction System (AQPS) which will forecast, up to eight hours in advance of real time, the possibility of air pollution exceeding the provincial air quality standard in the Fort McMurray area, so that mitigating actions can be taken.

Syncrude is the operator of the project which is anticipated to be completed by June 1986. The total cost will be $2,392,200 with AOSTRA to pay one-third of the project cost ($797,400).

9.4 Hycal Energy Research Laboratories Limited

AOSTRA is also participating in a cooperative industry-supported laboratory research program to investigate the effects of CO_2 in displacing heavy oil and bitumen. The program is being conducted by Hycal Energy Research Laboratories Limited in Calgary at a cost of $230,000 over two years.

9.5 Hatch Associated Limited

AOSTRA committed $383,950 to Hatch Associates Limited to carry out two-dimensional scaled model laboratory studies for demonstrating gravity drainage from a modeled in situ bitumen or heavy oil element using carbon dioxide or ethane for viscosity reduction of the oil, and to derive a mathematical model of describing gravity drainage enhanced by dissolution of carbon dioxide or ethane into bitumen or heavy oil. AOSTRA is currently evaluating the final results.

9.6 British Columbia Research Council

AOSTRA and B.C. Research Council have agreed to jointly fund a research project for developing, preparing, and testing new low-cost aminopolysaccharides obtained from readily available cellulose as water-thickening agents. These agents may have potential use as mobility control materials for enhanced oil recovery.

AOSTRA agreed to provide up to a maximum total of $67,000 which is one-half of the cost of carrying out the project. The balance of funding will be the responsibility of the B.C. Research Council which is also the operator of the project.

10 Inventors Grant Assistance Program

[illegible] implemented in 1983, was continued during fiscal 1984. The purpose of IGAP is to encourage and assist inventors to develop inventions beyond the idea and concept stage so that conventional funding for commercialization may be obtained. Amounts to a maximum of $50,000 may be awarded to individuals or companies for use in developing inventions. AOSTRA does not earn any use rights to the inventions and the only requirement on the part of the inventor is a commitment to use the funds in the development of the invention and to supply both accounting and technical reports to AOSTRA.

This continues to be a popular program with a total of 22 applications being received during the year. Six of these applications were approved for funding and a total of $174,780 has been granted to inventors, bringing the total amount of grants made since the IGAP program was implemented to $405,921. The following awards have been made under the program during the past year.

IGAP Recipient	Amount of Grant	Activity Supported
B.H. Walter	$ 40,000	To build and test a prototype downhole tool to enhance rock chip removal and increase drilling penetration rate.
R.J. Niell	$ 30,000	To build and test an electronic device designed to prevent a drilling rig main block from moving beyond preset upper and lower limits.
C.B. Johnson	$ 12,680	To do laboratory tests to confirm whether or not bitumen can be extracted from oil sands by a novel process using solid absorbent beads.
Steblyk-Mills Industries Ltd.	$ 50,000	To build and test a bottom hole pump powered by rotating the tubing string.
T.C. Elliot	$ 2,100	To conduct laboratory tests to establish the parameters for a process to upgrade heavy oil emulsions to pipeline or equivalent specifications.
Szantech Machine Tool Inc.	$ 40,000	To build and test prototypes of a patented downhole hydraulic cable cutter and a hydraulic tubing punch.

11 International Program

[illegible] depressed international economic climate has reduced short-term prospects for significant sales of AOSTRA technology. Cooperative efforts are continuing, however, and there has been strong emphasis on the promotion of Alberta goods and services.

AOSTRA personnel during the year visited the People's Republic of China, Romania, Albania, and the United States to pursue technical interests. A two-person delegation from AOSTRA traveled to the People's Republic of China to further evaluate their technology and the prospects for cooperation.

12 Training Program

[illegible] employing new graduates in temporary jobs.

13 Industrial Post-Doctoral Fellowship Program

In 1983 AOSTRA implemented its industrial Post-Doctoral Fellowship Program which was designed to assist the transition of post-doctoral researchers from an academic to an industrial environment. During the two-year term of the award, valued at $22,500 per year, the AOSTRA Industrial Fellow conducts a research project in the laboratory of the sponsoring company which provides the space, equipment, and support personnel required for the proper conduct of the research. Dr. N.S. Srinivasan, the current holder of the award, is studying the consequences of the presence of natural surfactants released from bitumen by the hot water process, at the Syncrude Canada Limited laboratories in Edmonton.

14 Methods for Acquiring AOSTRA Technology

funded by AOSTRA is available under fair business terms.

14.1 Completed Projects

For those projects which are completed, a potential purchaser of information or use rights may negotiate with AOSTRA to arrive at a suitable acquisition price. This price is dependent upon the usefulness of the technology rather than the cost of developing it.

14.2 Active Projects

Technology may also be accessed on an ongoing basis from a currently operating project by joining the project as an active participant. The minimum basis of participation is a 12½% interest with the participant having voting rights and a world wide license fee-free right to use the technology. An alternative approach is through the consultive participant role in which the participant pays less than 12½% of the cost and does not have voting privileges but does, however, acquire technology use rights.

14.3 University Research Projects

Over the past year, a total of ten companies have been accessing the results from the university projects. These industry participants collectively pay more than 24% of the cost of the university activity. Under this access program, the companies earn use rights and have the privilege of visiting the various laboratories and consulting with the researchers.

14.4 Joint AOSTRA/ARC Laboratory Program

There are currently four companies participating in this access program. This program provides for the use of the technology without fee and for meaningful input into the direction and content of the research work. The companies have been actively involved in this research and have been providing useful advice to those conducting the experimental work.

14.5 The Data Base Management System

As outlined in Section 1.12, the ADBS provides full data storage, access, and reporting for in situ pilot projects. Five companies operating six projects are currently using the system. Licensing arrangements are made between AOSTRA and individual companies with system charges being directly related to the volume of data and amount of use. AOSTRA will arrange for a "live demonstration" of system capabilities for interested companies.

15 Technical Review

manager and established an office to conduct an independent technical review of all of AOSTRA's activities since its formation in 1975. This resulted in the preparation, by AOSTRA staff and consultants familiar with AOSTRA activities, of 46 synopsis reports summarizing in concise format the technology which AOSTRA had developed. The second phase of the technical review consisted of a review of each project or technology area by a team of two independent consultants chosen for their knowledge and impartiality. A total of 44 technical reviews were conducted during the period October 1984 and March 1985. The results and recommendations arising from these confidential reports are presently being reviewed by AOSTRA Members with a view to increasing AOSTRA's relevance, success, effectiveness, and efficiency.

16 AOSTRA Journal of Research

of research and development technology related to bituminous sands, heavy oils, oil source rocks, and tertiary recovery of conventional petroleum (see Report of Activities Section for editorial and subscription information).

17 Patents

The following patents and patent applications are assigned to AOSTRA:

a) Canadian Patents

Patent No.	Date Issued	Patent Title
1,120,418	Mar 23/82	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)
1,121,749	Apr 3/82	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
1,102,234	Jun 2/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1,122,015	Apr 20/82	Process for Microbiologically Leaching Coke (T.R. Jack et al)
1,129,801	Aug 17/82	Alkali Recycle Process for Recovery of Heavy Oils and Bitumens (M.A. Kessick)
1,134,174	Oct 26/82	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
1,158,458	Dec 13/83	Variable Drive for Pump Jack (D.L. Buckler)
1,120,367	Jun 7/84	Catalytic Sulfur Removal from Hydrocarbons (P.M. Boorman et al)
1,170,444	Jul 10/84	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne and J.D. Tyrer)
1,171,382	Jul 24/84	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
1,844,022	Mar 19/85	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)

b) Canadian Patent Applications

Application No.	Date Filed	Patent Application Title
379,072	Feb 22/83	Improved Process for Recovery of Residual Bitumen from Tailings from Oil Sand Extraction Plants (E.L. Tollefson and E.S. Hall)
434,617	Aug 15/83	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)
450,276	Mar 22/84	Process for Upgrading Heavy Viscous Oil (Hydrocarbon)(I. Lutz)(Acres Davy Mckee DM International, Inc., Houston)

c) U.S. Patents

Patent No.	Date Filed	Patent Title
4,180,455	Dec 25/79	Process for Thermally Cracking a Heavy Hydrocarbon (W. Taciuk)
4,280,879	Jul 28/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
4,306,961	Dec 22/81	Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk — Tarsand Version)
4,285,773	Aug 25/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk — Lloydminster Version)
4,312,234	Jan 26/82	Two-Phase Wet Steam Flow Meter (D.S. Scott and E. Rhodes)
4,271,905	Jun 9/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
4,406,499	Sep 27/83	Method of In Situ Bitumen Recovery by Percolation (M.A. Kessick)
4,438,218	Mar 20/84	Catalytic Sulfur Removal from Hydrocarbons (P.M. Boorman et al)
4,454,023	Jul/Aug/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International, Inc., Houston)
4,458,759	Jul 10/84	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)
4,487,264	Dec 11/84	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne and J.D. Tyrer)
4,501,648	Feb 26/85	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
4,506,733	Mar 26/85	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

d) U.S. Patent Applications

Application No.	Date Filed	Patent Application Title
06/294,523	Aug 20/81	Variable Speed Pump Jack (D.L. Buckler)

e) Venezuela Patent Applications

Application No.	Date Filed	Patent Application Title
0067	Jan 21/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1933	Oct 31/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)
264	Feb 25/80	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
991/80	Jun 10/80	Process for Microbiologically Leaching Coke (J. Zajic/Sullivan)
785/81	May 9/81	Two-Phase Wet Steam Flow Meter (D.S. Scott and E. Rhodes)
108/82	Jan 22/82	Wet Combustion Process (D.W. Bennion, R.G. Moore, and K. Donnelly)
1299/82	Jul 21/82	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne/J.D. Tyrer)
1803/83	Nov 11/83	Additive for inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

f) Mexico Patent Application

Application No.	Date Filed	Patent Application Title
179,758	Oct 24/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)
200,744	Mar 22/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM)

g) European (EEC) Patents

Patent No.	Date Filed	Patent Title
0-028-666	Apr 6/83	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk) (Belgium, France, Italy, Netherlands, and U.K.)
79,302542.0	(Sweden)	
29-65-154.5	(Germany)	
81.304752.9	Oct 13/81	Two-Phase Flowmeter (D.S. Scott and E. Rhodes)
84.301888.8	Mar 20/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International, Inc., Houston)

h) Argentina Patent Applications

Application No.	Date Filed	Patent Application Title
279,427	Dec 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)

i) Romania Patent Applications

Application No.	Date Filed	Patent Application Title
99095	Oct 30/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)

j) Turkey Patent Applications

Application No.	Date Filed	Patent Application Title
144261	Dec 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)

k) Japan Patent Applications

Application No.	Date Filed	Patent Application Title
138227/79	Oct 25/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W.Taciuk)
172665/81	Oct 28/81	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
054111/84	Mar 21/84	Process for Upgrading a Heavy Viscous Oil (Hydrocarbon) (I. Lutz) (Acres Davy McKee DM International Inc., Houston)

17.2 Prior Company Patents (for which AOSTRA has acquired certain licensing rights)

a) Canadian Patents

	Canadian Patent No.	Date Issued	Date Filed	Related U.S. Patent No.	Patent Title
1.	787182	06-11-68	10-18-63	3244229	Production of Fluids From Unconsolidated Formations
2.	794324	10-10-68	05-04-65	—	Separation Process
3.	794670	10-17-68	10-27-65	—	Method of Producing Hydrocarbons
4.	803818	01-14-69	05-13-66	3244229	Production of Fluids From Unconsolidated Formations
5.	806945	02-25-69	12-06-65	—	Well Pump
6.	815802	06-24-69	11-22-66	—	Valve for Obtaining a Sample of the Fluid Flowing in a Pipeline
7.	820083	08-12-69	02-20-67	3366177	Production of Petroleum from Unconsolidated Formations
8.	839042	04-14-70	03-18-66	—	Method of Producing Hydrocarbons from a Subsurface Formation by Thermal Treatment
9.	840211	03-28-70	01-17-66	—	Method of Recovering Hydrocarbons from an Underground Hydrocarbon-Containing Formation
10.	840789	05-05-70	01-17-66	—	Method of Producing Hydrocarbons from an Underground Formation
11.	856023	11-17-70	02-23-68	—	Consolidating Earth Formations
12.	858309	12-15-70	23-68	—	Thermal Secondary Recovery
13.	890741	01-18-72	02-21-69	—	Method of Recovering Hydrocarbons from an Underground Hydrocarbon-Containing Formation
14.	941735	02-12-74	06-01-71	—	Oil Recovery Using Steam and Chemical Drive Fluids
15.	1125649	15-06-82	19-12-79	4234042	Direct Combustion Stimulation of a Producing Well
16.	1118341	16-02-82	14-09-79	4272487	Indirect Thermal Stimulation of Producing Wells

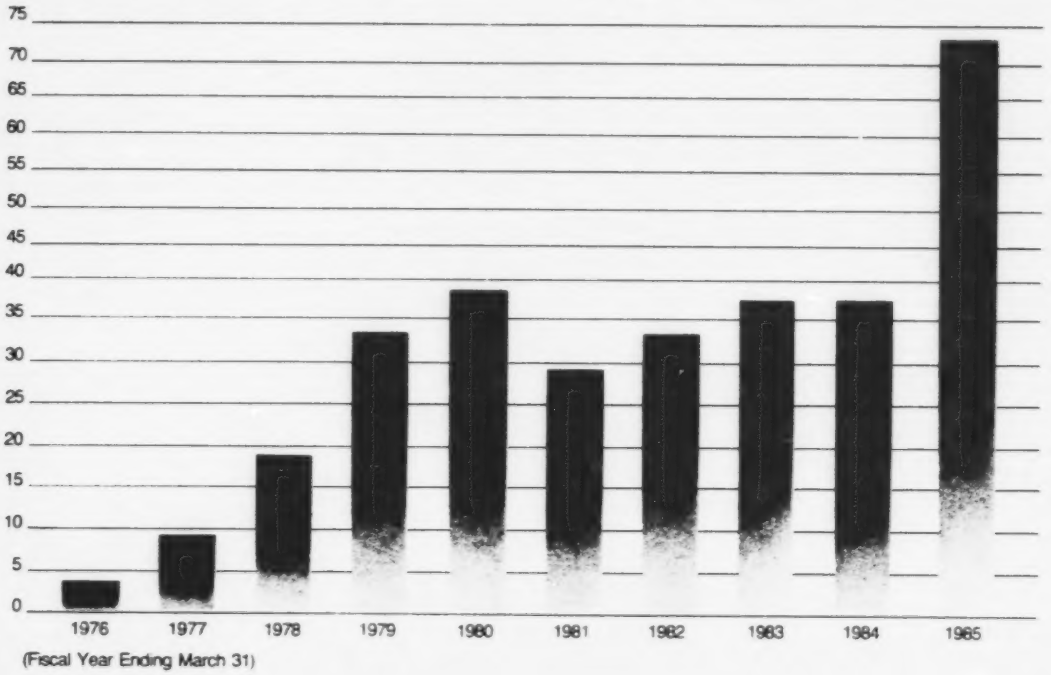
b) U.S. Patents

	Patent No.	Date Issued	Date Filed	Related Canadian Patent No.	Patent Title
1.	3372750	03-12-68	11-19-65	827466	Recovery of Heavy Oils by Steam Injection
2.	3375870	04-02-68	11-19-65	827467	Recovery of Petroleum by Thermal Methods
3.	3384172	05-21-68	11-19-65	—	Producing Petroleum by Forward Combustion and Cyclic Steam Injection
4.	3399722	09-03-68	05-24-67	847137	Recovery of Petroleum by a Cyclic Thermal Method
5.	3434544	03-25-69	12-22-66	—	Method for Conducting Cyclic Steam Injection to Recover Hydrocarbons
6.	3459265	08-05-69	07-28-67	849320	Method for Recovering Viscous Oil by Steam Drive
7.	3460621	08-12-69	05-22-67	848245	Cyclic Steam Injection and Gas Drive
8.	3464491	09-02-69	12-18-67	848244	Oil Recovery from Formations Containing Channels
9.	3481399	12-02-69	06-10-68	866576	Recovery of Oil by Flashing of Heated Connate Water
10.	3504745	04-07-70	05-08-68	853995	Use of Foams to Prevent Vertical Flow in Tar Sands During In Situ Combustion
11.	3547195	12-15-70	06-19-69	881914	Pyrolitic Plugging of Oil Bearing Formations by Underground Combustion
12.	3430700	03-04-69	10-16-66	852555	Recovery of Petroleum by Thermal Methods Involving Transfer of Heat from One Section of an Oil Bearing Formation to Another
13.	3729337	04-24-73	04-20-70	—	Production of Petroleum from Unconsolidated Formations
14.	3964547	06-22-76	10-29-74	972679	Use of Tar as a Diverter in Steaming Operations
15.	4147213	04-03-79	—	—	Combustion Air Injection Well
16.	4234042	18-11-80	11-06-79	1125649	Direct Combustion Stimulation of a Producing Well
17.	4272487	—	01-01-79	1118341	Indirect Thermal Stimulation of Producing Wells

Tables and Figures

Annual Investment by AOSTRA in Oil Sands and Heavy Oil Technology (1976-1985)

Figure 2



Commitments from AOSTRA Research Fund To March 31, 1985 ($ Millions)

Figure 3

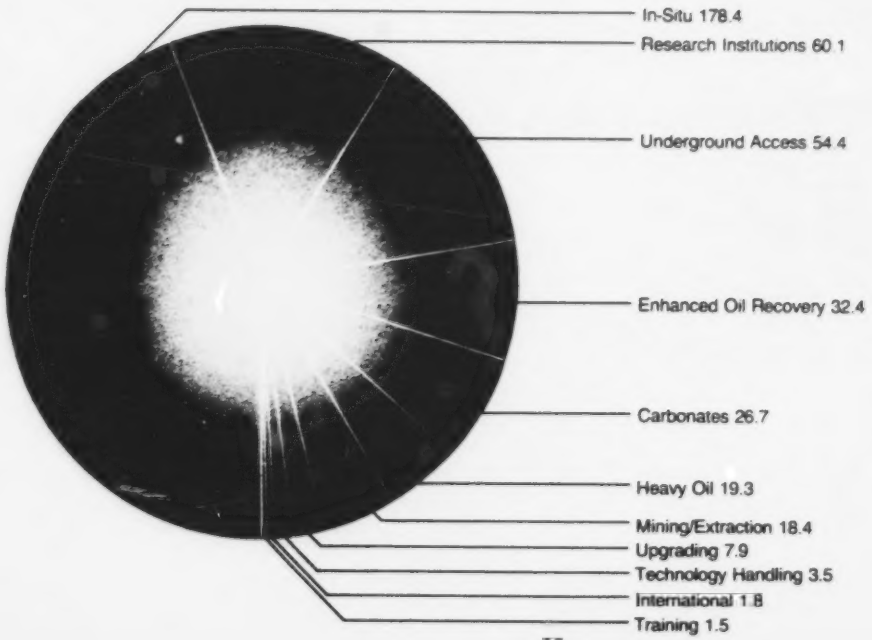


Table 1

Summary of Funds Committed and Disbursed to March 31, 1985

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/84 to March 31/85	Balance
Institutional Research				
Alberta Research Council				
— Information Centre	$ 3,205,000	$ 2,640,579	$ 551,962	$ 12,459
— Oil Sands Research Centre	21,043,027	17,345,170	2,915,270	782,587
— Sample Bank	1,577,868	1,002,805	93,205	481,858
— Geological Program	2,915,009	2,054,887	753,092	107,030
— Hydrocarbon Program	2,250,000	—	530,872	1,719,128
Inventors Assistance Grant	500,000	130,000	180,780	189,220
University Contracts	18,678,810	14,247,449	2,994,843	1,436,518
Professorships	3,499,705	2,363,763	560,622	575,320
Post Doctoral Fellowships	100,000	1,040	22,500	76,460
Scholarships and Fellowships	2,180,000	1,271,028	388,920	520,052
Hatch and Associates	383,950	246,258	122,014	15,678
Ontario Research Foundation	10,700	6,099	—	4,601
British Columbia Cancer Foundation	125,000	106,640	5,466	12,894
British Columbia Research Council	67,600	—	49,500	18,100
ARC — Access Program	25,000	4,244	514	20,242
University Access Program	150,000	133,730	13,861	2,409
Program Planning and Evaluation	500,000	120,486	85,675	293,839
Technical Review	1,084,000	72,438	798,958	212,604
Petroleum Recovery Institute	1,063,690	514,315	547,690	1,685
Syncrude Canada Ltd	797,400	581,730	(26,694)	242,364
	$ 60,156,759	$ 42,842,661	$ 10,589,050	$ 6,725,048
Mining and Extraction				
Retorting				
— Umatac	$ 12,550,000	$ 8,778,933	$ 2,948,229	$ 822,838
— Lurgi	721,820	545,020	—	176,800
Tailings Treatment				
— Xana	2,457,879	2,384,746	(13,261)	86,394
— EcoPlastics	63,318	59,917	—	3,401
Dredging	202,658	202,459	—	199
Solvent Study	26,343	26,343	—	—
Oil Sands Demonstration Centre	1,025,000	226,998	36,935	761,067
Kruyer Research	340,000	340,000	—	—
Suncor/Kruyer Project	615,000	60,000	378,679	176,321
R.T.R. Project	100,000	100,000	—	—
Nova/Husky/Canstar	120,000	65,889	54,105	6
Inpro Engineering	161,930	5,338	144,327	12,265
	$ 18,383,948	$ 12,795,643	$ 3,549,014	$ 2,039,291

Table 1

Summary of Funds Committed and Disbursed to March 31, 1985 (continued)

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/84 to March 31/85	Balance
In Situ Oil Sands				
Peace River				
— Shell	$ 73,839,351	$ 63,205,026	$ 806,095	$ 9,828,230
Athabasca				
— Amoco	24,947,108	24,739,144	(726,689)	934,653
— Amoco/Petro-Canada	17,108,250	—	5,854,969	11,253,281
— Numac/Gulf	1,490,661	1,449,465	—	41,196
— Hudson's Bay	100,000	36,843	—	63,157
— Canterra Energy Ltd	30,061,000	6,236,384	15,199,377	8,625,239
— Petro-Canada/Esso	3,500,000	3,500,000	—	—
— Texaco Canada	1,515,000	41,570	1,340,947	132,483
Wabasca				
— General American	1,500,000	1,321,891	—	178,109
Cold Lake				
— B.P	20,811,000	15,835,232	3,474,113	1,501,655
— B.P./Petro-Canada	1,499,250	—	192,092	1,307,158
— Colt Engineering	39,500	40,330	—	(830)
— Suncor - Ft. Kent	100,000	14,641	75,739	9,620
— Technica	7,000	—	5,645	1,355
Gemini	264,211	260,370	—	3,841
Walden	96,500	96,614	—	(114)
Francis Hankin	457,009	405,600	26,500	24,909
Monenco	38,000	38,000	—	—
Mineralogical Study	6,250	1,001	—	5,249
Waterloo Centre	424,694	418,693	—	6,001
Chevron	—	—	506	(506)
Electrical Heating Study	186,000	133,766	39,007	13,227
Water Treatment Study	408,480	132,621	153,273	122,586
Consultants	36,430	30,600	—	5,830
	$178,435,694	$117,937,791	$ 26,441,574	$ 34,056,329
Underground Access				
Athabasca				
— Tunnelling	$ 177,390	$ 177,390	$ —	$ —
— Gulf Surmont Project	4,935,143	4,930,874	—	4,269
— U.T.F. Project	49,281,947	4,666,435	19,452,415	25,163,097
	$ 54,394,480	$ 9,774,699	$ 19,452,415	$ 25,167,366
Carbonate Trend				
Buffalo Creek				
— Union Oil	$ 26,685,000	$ 21,553,218	$ 4,380,864	$ 750,918
Heavy Oil				
Petro-Canada	$ 13,458,046	$ 11,903,396	$ 1,541,199	$ 13,451
A.E.C	5,576,500	4,959,731	349,412	267,357
Pengalta	283,253	183,204	56,470	43,579
	$ 19,317,799	$ 17,046,331	$ 1,947,081	$ 324,387

Table 1

Statement of Funds Committed and Disbursed to March 31, 1985 (continued)

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/84 to March 31/85	Balance
Enhanced Recovery Conventional Oil				
Vikor Resources Ltd	$ 18,375,000	$ 4,666,445	$ (1,036,981)	$ 14,745,536
P.R.I.	1,000,000	827,471	—	172,529
PanCanadian Petroleum	1,500,000	116,017	334,175	1,049,808
McCallum, Stewart & Associates	27,000	26,673	—	327
Husky Oil	200,000	155,383	(6,439)	51,056
Norcen	125,000	88,802	9,613	26,585
Cold Lake Heavy Oil	11,112,000	351,550	5,663,041	5,097,409
D.B. Robinson	17,125	17,325	—	(200)
Hycal Energy	11,500	8,625	—	2,875
	$ 32,367,625	$ 6,258,291	$ 4,963,409	$ 21,145,925
Bitumen Upgrading				
Flexicoking — Exxon	$ 500,000	$ 353,829	$ —	$ 146,171
Hydrocracking — E.M.R	214,520	214,520	—	—
Hydrotreating — UOP	176,183	176,183	—	—
— Catalytic Inc	206,640	201,172	—	5,468
Residue Utilization Project	1,090,000	34,375	521,675	533,950
Heavy Oil Upgrading Demo Centre	85,000	13,061	20,391	51,548
Bitumen/Water Transportation Study	80,000	—	15,751	64,249
Heavy Oil Upgrading Study	1,856,500	1,856,459	30	11
Fluid Bed Combustion				
— EMR/Ahlstrom Test	12,500	3,026	—	9,474
— British Columbia Research Council	99,570	80,108	19,462	—
Petrochemicals — Mitsubishi	679,500	680,593	—	(1,093)
Eureka Process	433,755	433,755	—	—
California Synfuels	414,760	236,135	33,859	144,766
REM Feasibility Study	125,000	125,000	—	—
McKinsey & Associates Study	75,000	75,000	—	—
Porta Plants Inc	10,000	8,097	—	1,903
Gulf Oil — Donor Process	1,577,000	390,000	437,000	750,000
Raylo Chemicals	115,446	111,046	—	4,400
Advanced Fuel Research	25,830	18,804	8,418	(1,392)
RTM/ARC Process	25,000	16,214	8,786	—
Battelle Laboratories	50,000	33,582	248	16,170
Murphy Oil	50,000	—	28,049	21,951
Acres Davey McKee	80,000	—	20,000	60,000
	$ 7,982,204	$ 5,060,959	$ 1,113,669	$ 1,807,576
Technology Handling				
Data Base Administration	$ 2,752,515	$ 1,973,788	$ 502,730	$ 275,997
Technical Reports	91,865	91,865	—	—
AOSTRA Journal	160,000	37,687	124,471	(2,158)
Patent Costs	500,000	353,277	68,142	78,581
	$ 3,504,380	$ 2,456,617	$ 695,343	$ 352,420
Training Activities	$ 1,555,000	$ 1,026,005	$ 243,757	$ 285,238
International Activities	$ 1,780,800	$ 979,039	$ 444,666	$ 357,095
Authority Costs	$ 1,000,000	$ —	$ 37,726	$ 962,274
Totals	$405,563,689	$237,731,254	$ 73,858,568	$ 93,973,867

Table 2

Oil Sands Technology and Research Fund
Ten Year Summary
For the years ended March 31

Statement of Revenue
Expenditures and Fund Balance

	1985	1984	1983	1982
Revenue				
Alberta Heritage Savings Trust Fund	$50,000,000	$54,500,000	$39,500,000	$28,500,000
Technology sales	2,056,808	1,988,107	2,876,477	3,477,561
	$52,056,808	$56,488,107	$42,376,477	$31,977,561
Expenditures				
Institutional Research				
Alberta Research Council				
— Information Centre	$ 551,962	$ 495,183	$ 438,174	$ 394,205
— Oil Sands Research Centre	2,915,270	3,236,077	2,877,172	2,369,308
— Sample Bank	93,205	134,761	261,881	240,975
— Geological Program	753,092	642,157	521,195	469,740
— Hydrocarbon Program	530,872	—	—	—
Inventors Assistance Grant	180,780	130,000	—	—
University Contracts	2,994,843	3,152,248	3,478,549	2,103,367
Professorships	560,622	461,515	546,121	472,084
Post Doctoral Fellowships	22,500	1,040	—	—
Scholarships and Fellowships	388,920	383,807	184,823	201,760
Hatch & Associates	122,014	246,258	—	—
Ontario Research Foundation	—	—	—	1,622
British Columbia Cancer Foundation	5,466	63,514	43,126	
British Columbia Research Council	49,500	—	—	—
ARC — Access Program	514	4,244	—	—
University Access Program	13,861	35,918	26,771	44,159
Program Planning and Evaluation	85,675	120,486	—	—
Technical Review	798,958	72,438	—	—
Petroleum Recovery Institute	547,690	514,315	—	—
Syncrude Canada Ltd	(26,694)	581,730	—	—
	$10,589,050	$10,275,691	$ 8,377,812	$ 6,297,220
Mining and Extraction				
Retorting				
— Umatac	$ 2,948,229	$ 2,800,255	$ 1,532,063	$ 1,348,402
— Lurgi	—	38,579	(114,724)	—
Tailings Treatment				
— Xana	(13,261)	332,585	692,663	617,160
— EcoPlastics	—	—	—	—
Dredging	—	(43)	174,844	—
Solvent Study	—	—	—	—
Oil Sands Demonstration Centre	36,935	218,782	(33,106)	18,253
Kruyer Research	—	—	100,000	240,000
Suncor/Kruyer Project	378,679	60,000	—	—
R.T.R. Project	—	—	—	100,000
Nova/Husky/Canstar	54,105	65,889	—	—
Inpro Engineering	144,327	5,338	—	—
	$ 3,549,014	$ 3,521,385	$ 2,351,740	$ 2,323,815

1981	1980	1979	1978	1977	1976	Total
$28,000,000	$38,000,000	$33,161,289	$20,290,523	$ 9,497,220	$ —	$301,449,032
2,362,893	282,312	407,623	3,000	12,027	—	13,466,808
$30,362,893	$38,282,312	$33,568,912	$20,293,523	$ 9,509,247	$ —	$314,915,840
$ 313,017	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 3,192,541
2,508,783	1,336,003	1,294,191	923,636	1,400,000	1,400,000	20,260,440
218,361	65,763	22,064	59,000	—	—	1,096,010
353,953	67,842	—	—	—	—	2,807,979
—	—	—	—	—	—	530,872
—	—	—	—	—	—	310,780
1,975,243	1,291,193	880,585	634,341	731,923	—	17,242,292
353,813	167,730	160,000	147,500	55,000	—	2,924,385
—	—	—	—	—	—	23,540
85,131	121,541	107,530	136,516	49,920	—	1,659,948
—	—	—	—	—	—	368,272
4,477	—	—	—	—	—	6,099
—	—	—	—	—	—	112,106
—	—	—	—	—	—	49,500
—	—	—	—	—	—	4,758
26,882	—	—	—	—	—	147,591
—	—	—	—	—	—	206,161
—	—	—	—	—	—	871,396
—	—	—	—	—	—	1,062,005
—	—	—	—	—	—	555,036
$ 5,839,660	$ 3,250,072	$ 2,664,370	$ 2,100,993	$ 2,436,843	$ 1,600,000	$ 53,431,711
$ 812,790	$ 653,734	$ 528,210	$ 1,103,479	$ —	$ —	$ 11,727,162
239,075	319,870	—	—	55,979	6,241	545,020
333,242	223,455	170,594	15,047	—	—	2,371,485
16,829	16,598	26,490	—	—	—	59,917
—	16,760	10,898	—	—	—	202,459
—	26,343	—	—	—	—	26,343
23,069	—	—	—	—	—	263,933
—	—	—	—	—	—	340,000
—	—	—	—	—	—	438,679
—	—	—	—	—	—	100,000
—	—	—	—	—	—	119,994
—	—	—	—	—	—	149,665
$ 1,425,005	$ 1,256,760	$ 736,192	$ 1,118,526	$ 55,979	$ 6,241	$ 16,344,657

Table 2

Statement of Revenue

	1985	1984	1983	1982
In—Situ Oil Sands				
Peace River				
— Shell	$ 806,095	$ 3,037,950	$ 3,416,430	$ 7,413,067
Athabasca				
— Amoco	(726,689)	(66,986)	234,416	1,865,234
— Amoco/Petro-Canada	5,854,969	—	—	—
— Numac/Gulf	—	(285)	286	(36)
— Hudson's Bay	—	—	—	—
— Canterra Energy Ltd	15,199,377	46,384	6,190,000	—
— Petro-Canada/Esso	—	3,500,000	—	—
— Texaco Canada	1,340,947	41,570	—	—
Wabasca				
— General American	—	37,211	1,284,680	
Cold Lake				
— B.P.	3,474,113	878,117	2,429,899	3,231,266
— B.P./Petro-Canada	192,092	—	—	—
— Colt Engineering	—	40,330	—	—
— Suncor-Ft. Kent	75,739	14,641	—	—
Technica	5,645	—	—	—
Gemini	—	—	37,339	123,544
Walden	—	—	—	9,346
Francis Hankin	26,500	379,905	25,695	—
Monenco	—	—	3,000	35,000
Mineralogical Study	—	1,001	—	—
Waterloo Centre	—	189,046	118,314	111,333
Chevron	506	—	—	—
Electrical Heating Study	39,007	96,323	31,149	6,294
Water Treatment Study	153,273	133,767	(4,283)	3,137
Consultants	—	—	—	—
	$26,441,574	$ 8,328,974	$13,766,925	$12,798,185
Underground Access				
Athabasca				
— Tunnelling	$ —	$ —	$ —	$ —
— Gulf Surmont Project	—	21,192	(20,803)	1,461,788
— U.T.F. Project	19,452,415	3,376,745	1,289,690	—
	$19,452,415	$ 3,397,937	$ 1,268,887	$ 1,461,788
Carbonate Trend				
Buffalo Creek				
— Union Oil	$ 4,380,864	$ 2,950,100	$ 6,385,525	$ 4,812,576
Heavy Oil				
Petro-Canada	$ 1,541,199	$ 993,554	$ 2,105,364	$ 1,577,690
A.E.C	349,412	224,545	311,857	1,617,001
Pengalta	56,470	25,934	36,808	102,475
	$ 1,947,081	$ 1,244,033	$ 2,454,029	$ 3,297,166

1981	1980	1979	1978	1977	1976	Total
$ 6,510,798	$22,074,583	$18,204,757	$ 2,547,441	$ —	$ —	$ 64,011,121
4,241,687	3,086,470	3,298,545	6,983,208	5,096,570	—	24,012,455
—	—	—	—	—	—	5,854,969
(20,846)	129,684	140,662	1,200,000	—	—	1,449,465
3,199	33,372	272	—	—	—	36,843
—	—	—	—	—	—	21,435,761
—	—	—	—	—	—	3,500,000
—	—	—	—	—	—	1,382,517
—	—	—	—	—	—	1,321,891
991,585	948,474	1,645,018	4,492,932	1,217,941	—	19,309,345
—	—	—	—	—	—	192,092
—	—	—	—	—	—	40,330
—	—	—	—	—	—	90,380
—	—	—	—	—	—	5,645
99,487	—	—	—	—	—	260,370
87,268	—	—	—	—	—	96,614
—	—	—	—	—	—	432,100
—	—	—	—	—	—	38,000
—	—	—	—	—	—	1,001
—	—	—	—	—	—	418,693
—	—	—	—	—	—	506
—	—	—	—	—	—	172,773
—	—	—	—	—	—	285,894
—	6,630	23,970	—	—	—	30,600
$11,913,178	$26,279,213	$23,313,224	$15,223,581	$ 6,314,511	$ —	$144,379,365
$ —	$ 17,970	$ 39,823	$ 32,732	$ 86,865	$ —	$ 177,390
3,101,732	366,965	—	—	—	—	4,930,874
—	—	—	—	—	—	24,118,850
$ 3,101,732	$ 384,935	$ 39,823	$ 32,732	$ 86,865	$ —	$ 29,227,114
$ 2,111,852	$ 1,993,570	$ 3,299,595	$ —	$ —	$ —	$ 25,934,082
$ 1,135,972	$ 4,834,786	$ 1,256,030	$ —	$ —	$ —	$ 13,444,595
2,747,632	58,696	—	—	—	—	5,309,143
417	17,570	—	—	—	—	239,674
$ 3,884,021	$ 4,911,052	$ 1,256,030	$ —	$ —	$ —	$ 18,993,412

Table 2

Statement of Revenue
Expenditure & Fund Balance

	1985	1984	1983	1982
Enhanced Recovery Conventional Oil				
Vikor Resources Ltd	$(1,036,981)	$ 4,666,445	$ —	$ —
P.R.I.	—	553,804	(66,805)	304,915
PanCanadian Petroleum	334,175	116,017	—	—
McCallum, Stewart & Associates	—	—	3,427	23,246
Husky Oil	(6,439)	33,445	121,938	—
Norcen	9,613	3,513	85,289	—
Cold Lake Heavy Oil	5,663,041	111,290	240,260	—
D.B. Robinson	—	17,325	—	—
Hycal Energy	—	8,625	—	—
	$ 4,963,409	$ 5,510,464	$ 384,109	$ 328,161
Bitumen Upgrading				
Flexicoking — Exxon	$ —	$ —	$ —	$ —
Hydrocracking—E.M.R.	—	—	—	—
Hydrotreating—UOP	—	—	—	—
— Catalytic Inc	—	—	2,740	53,747
Residue Utilization Project	521,675	23,730	10,645	—
Heavy Oil Upgrading Demo Centre	20,391	13,061	—	—
Bitumen/Water Transportation Study	15,751	—	—	—
Heavy Oil Upgrading Study	30	202,520	1,094,500	494,281
Fluid Bed Combustion				
— EMR/Ahlstrom Test	—	—	—	3,026
— British Columbia Research Council	19,462	—	80,108	—
Petrochemicals — Mitsubishi	—	953	3,787	2,853
Eureka Process	—	—	417,437	16,318
California Synfuels	33,859	223,378	—	12,757
REM Feasibility Study	—	—	38,586	86,414
McKinsey & Associates Study	—	—	42,000	33,000
Porta Plants Inc	—	4,465	3,632	—
Gulf Oil — Donor Process	437,000	390,000	—	—
Raylo Chemicals	—	111,046	—	—
Advance Fuel Research	8,418	18,804	—	—
RTM/ARC Process	8,786	16,214	—	—
Battelle Laboratories	248	33,582	—	—
Murphy Oil	28,049	—	—	—
Acres Davy McKee	20,000	—	—	—
	$ 1,113,669	$ 1,037,753	$ 1,693,435	$ 702,396
Technology Handling				
Data Base Administration	$ 502,730	$ 654,653	$ 549,409	$ 333,810
Technical Reports	—	—	—	—
AOSTRA Journal	124,471	32,353	5,334	—
Patent Costs	68,142	110,307	45,886	52,277
	$ 695,343	$ 797,313	$ 600,629	$ 386,087
Training Activities	$ 243,757	$ 328,732	$ 289,725	$ 207,109
International Activities	$ 444,666	$ 325,160	$ 232,466	$ 244,408
Authority Costs	$ 37,726	$ —	$ —	$ —
	$73,858,568	$37,717,542	$37,805,282	$32,858,911
Excess of revenue over expenditures	$(21,801,760)	$18,770,565	$ 4,571,195	$ (881,350)
Fund balance at beginning of period	25,127,778	6,357,213	1,786,018	2,667,368
Fund balance at end of period	$ 3,326,018	$25,127,778	$ 6,357,213	$ 1,786,018

1981	1980	1979	1978	1977	1976	Total
$ —	$ —	$ —	$ —	$ —	$ —	$ 3,629,464
20,669	14,888	—	—	—	—	827,471
—	—	—	—	—	—	450,192
—	—	—	—	—	—	26,673
—	—	—	—	—	—	148,944
—	—	—	—	—	—	98,415
—	—	—	—	—	—	6,014,591
—	—	—	—	—	—	17,325
—	—	—	—	—	—	8,625
$ 20,669	$ 14,888	$ —	$ —	$ —	$ —	$ 11,221,700
$ —	$ —	$ —	$ —	$ —	$ 353,829	$ 353,829
—	—	—	—	—	214,520	214,520
—	88,785	87,398	—	—	—	176,183
144,685	—	—	—	—	—	201,172
—	—	—	—	—	—	556,050
—	—	—	—	—	—	33,452
—	—	—	—	—	—	15,751
65,158	—	—	—	—	—	1,856,489
—	—	—	—	—	—	3,026
—	—	—	—	—	—	99,570
2,877	265,855	359,194	45,074	—	—	680,593
—	—	—	—	—	—	433,755
—	—	—	—	—	—	269,994
—	—	—	—	—	—	125,000
—	—	—	—	—	—	75,000
—	—	—	—	—	—	8,097
—	—	—	—	—	—	827,000
—	—	—	—	—	—	111,046
—	—	—	—	—	—	27,222
—	—	—	—	—	—	25,000
—	—	—	—	—	—	33,830
—	—	—	—	—	—	28,049
—	—	—	—	—	—	20,000
$ 212,720	$ 354,640	$ 446,592	$ 45,074	$ —	$ 568,349	$ 6,174,628
$ 116,073	$ 198,691	$ 121,152	$ —	$ —	$ —	$ 2,476,518
91,865	—	—	—	—	—	91,865
—	—	—	—	—	—	162,158
66,184	78,623	—	—	—	—	421,419
$ 274,122	$ 277,314	$ 121,152	$ —	$ —	$ —	$ 3,151,960
$ 200,439	$ —	$ —	$ —	$ —	$ —	$ 1,269,762
$ 177,005	$ —	$ —	$ —	$ —	$ —	$ 1,423,705
$ —	$ —	$ —	$ —	$ —	$ —	$ 37,726
$29,160,403	$38,722,444	$31,876,978	$18,520,906	$ 8,894,198	$ 2,174,590	$311,589,822
$ 1,202,490	$ (440,132)	$ 1,691,934	$ 1,772,617	$ 615,049	$(2,174,590)	$ 3,326,018
1,464,878	1,905,010	213,076	(1,559,541)	(2,174,590)	—	—
$ 2,667,368	$ 1,464,878	$ 1,905,010	$ 213,076	$(1,559,541)	$(2,174,590)	$ 3,326,018

Auditor's Report and Financial Statements

Alberta Oil Sands
Technology and Research Authority
Oil Sands Technology and Research Fund
Financial Statements
March 31, 1985

Auditor's Report

Balance Sheet

Statement of Revenue, Expenditure and Fund Balance

Notes to the Financial Statements

ALBERTA LEGISLATURE

OFFICE OF THE AUDITOR GENERAL

Auditor's Report

To the Members of the Alberta Oil
Sands Technology and Research Authority

I have examined the balance sheet of the Alberta Oil Sands Technology and Research Authority — Oil Sands Technology and Research Fund as at March 31, 1985 and the statement of revenue, expenditure and fund balance for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Fund as at March 31, 1985 and the results of its operations for the year then ended in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

F.C.A.
Auditor General

Edmonton, Alberta
June 21, 1985

Alberta Oil Sands Technology and Research Authority
Oil Sands Technology and Research Fund

Balance Sheet

As at March 31, 1985

ASSETS	1985	1984
Current:		
Cash	$ 7,337,583	$27,092,505
Deposits in trust (Note 3)	2,694,143	429,799
Deposits on projects, net (Note 4)	2,214,826	2,269,128
Accounts receivable	1,899,745	856,163
Prepaid expense	10,874	13,356
	$14,157,171	$30,660,951

LIABILITIES		
Current:		
Accounts payable	$ 7,910,820	$ 5,103,374
Holdbacks payable	2,920,333	429,799
	10,831,153	5,533,173
Fund balance	3,326,018	25,127,778
	$14,157,171	$30,660,951

The accompanying notes are part of these financial statements.

Alberta Oil Sands Technology and Research Authority
Oil Sands Technology and Research Fund

Statement of Revenue, Expenditure and Fund Balance

For the Year Ended March 31, 1985

	1985	1984
Revenue:		
Contributions by the Province of Alberta:		
Alberta Heritage Savings Trust Fund (Note 6)	$50,000,000	$54,500,000
Technology sales	2,056,808	1,988,107
	52,056,808	56,488,107
Expenditure:		
In situ oil sands, net	26,441,574	8,328,974
Underground access	19,452,415	3,397,937
Institutional research	10,589,050	10,275,691
Enhanced recovery	4,963,409	5,510,464
Carbonate trend	4,380,864	2,950,101
Mining and extraction	3,549,014	3,521,385
Heavy oil, net	1,947,081	1,244,032
Bitumen upgrading	1,113,669	1,037,753
Technology handling	695,343	797,313
International activities	444,666	325,160
Training activities, net	243,757	328,732
Authority costs	37,726	—
	73,858,568	37,717,542
Excess of revenue over expenditure for the year	(21,801,760)	18,770,565
Fund balance at beginning of year	25,127,778	6,357,213
Fund balance at end of year	$ 3,326,018	$25,127,778

Notes to the Financial Statements

March 31, 1985

Note 1 Authority

The Alberta Oil Sands Technology and Research Authority operates under the authority of the Oil Sands Technology and Research Authority Act, Chapter 0-6, Revised Statutes of Alberta 1980.

Note 2 Significant Accounting Policies

The statements present Fund transactions only, therefore, those costs charged to the General Revenue Fund are not shown on the balance sheet or on the statement of revenue, expenditure and fund balance but are disclosed in Note 7.

Expenditures from the Fund are not capitalized due to the intangible nature of assets that may accrue to the Authority. The Authority will be entitled to share in any assets remaining at the end of a project in proportion to its percentage of participation.

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 Deposits in Trust

Deposits in trust consist of deposits in the General Trust Fund of the Province of Alberta.

Note 4 Deposits on Projects

The amount of $2,214,826 (1984 $2,269,128) shown on the balance sheet represents the net excess of cash calls on projects over actual expenditures.

Note 5 Advances from the Province of Alberta

The Oil Sands Technology and Research Authority Act provides for advances from the General Revenue Fund of the Province of Alberta not to exceed $100,000,000.

Note 6 Contributions by the Province of Alberta

The Appropriation (Alberta Heritage Savings Trust Fund, Capital Projects Division) Act, 1984-85 provided for payments to the Authority to a maximum of $50,000,000 for the year ended March 31, 1985 (1984 $68,000,000). Amounts actually received from this source totalled $50,000,000 (1984 $54,500,000). The provision which enables the Authority to receive funds up to the stated maximum lapses at the end of the fiscal year.

Note 7 Administration Costs

Administration Costs of the Authority, provided for by Section 13 of the Act, are paid by the Province from funds appropriated for that purpose and are summarized as follows:

	1985	1984
Salaries and wages	$1,696,585	$1,396,980
Fees and commissions	627,953	764,443
Rental of property and equipment	397,724	243,265
Employee benefits	205,731	180,210
Travelling and hospitality	181,740	178,395
Materials and supplies	80,363	49,335
Equipment maintenance	27,793	16,452
Freight, express and postage	19,965	4,159
Telephone and telegraph	14,033	7,507
Staff relocation costs	12,443	17,028
Furniture and equipment purchases	7,542	52,980
Grants	1,225	724
Advertising	—	9,472
	$3,273,097	$2,920,950

Note 8 Commitments

In addition to the total expenditure, the Authority had outstanding commitments as at March 31, 1985 totalling $93,973,867 (1984 $78,248,096) for approved projects.

Note 9 Comparative Figures

The 1984 figures have been restated where necessary to conform to 1985 presentation.

Note 10 Approval of Financial Statements

These financial statements were approved by management of the Authority.